SEVENTH ANNUAL REPORT

OF THE

OHIO (STATE)

ACADEMY OF SCIENCE.

PUBLICATION COMMITTEE:
F. M. WEBSTER, S. BELLE CRAVER,
E. L. MOSELEY.

1899

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1899.

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CONTENTS.

PAST PRESIDENTS.

1892. E. W. CLAYPOLE.
1893. EDWARD ORTON.
1894. F. M. WEBSTER.
1895. D. S. KELLICOTT.
1896. A. A. WRIGHT.
1897. W. A. KELLERMAN.
1898. W. G. TIGHT.

PAST SECRETARIES.

1892. W. R. LAZENBY.
1892–4. W. G. TIGHT.
1895–8. E. L. MOSELEY.

LIFE MEMBER.

McMillin, Emerson E., - - - 40 Wall St., New York.

MEMBERS.

Aiken, Walter H., Station K., Cincinnati
Albright, Prof. Chas. E , Columbus
Ayers, Annie B., - Wooster
Beardslee, Henry C., University School, - - Cleveland
Biscoe, Prof. Thos. D., Marietta
Blair, Kate R., 1457 Neil Avenue, Columbus
Bleile, Dr. Albert M., 218 King Ave., Columbus
Beer, Dr. James D., - Wooster
Bloomfield, Lloyd M., Marlboro
Bogue, Prof. E. E., Stillwater, Oklahoma Territory
Bonser, S. A., - - Carey
Bownocker, John A., Ohio State University, - Columbus
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Chandler, John Rice, National Archæologist, Gautemala, C. A.
Chapin, Prof. H. E., - Athens
Chapman, Joseph H., East Liverpool
Claassen, Edo, 429 Woodland Ave., - - - Cleveland
Clark, Dr. William, - Berea
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Clements, F. O., - Columbus
Colton, Prof. George H., Hiram
Comstock, Prof. Frank M., Case School, - - Cleveland
Cookson, Charles W., New Straitsville
Corson, H. C., - - Akron
Craver, Dr. S. Belle, - Toledo
Culler, J. A., - - Kenton
Cummins, J. A., - Greenwich
Cunningham, John F., O. S. U., Columbus
Cushing, H. P., - Cleveland
Davis, H. J., - Jacksontown
DeLong, George W., - Corning
Dodds, J. E., Fayette Normal University, - - Fayette
Dury, Dr. Chas. E., 524 Ridgway Ave., - - - Cincinnati
Duvel, J. W., Experiment Station, Wooster
Ehrenfeld A. C., - - Dayton
Feiel, Adolph, 520 East Main St., Columbus
Fitzpatrick, Dr. T. V., 32 Garfield Place, - - Cincinnati
Foerste, Aug. F., - Dayton
Fowke, Gerard, 46 W. Fourth St., Chillicothe
Graber, P. E., - - Genoa
Gill, George W., 287 East Broad St., - - - Columbus
Gillmore, E. A., 348 Grant St., Youngstown
Goodrich, Sarah F., - Geneva
Green, Isabelle M., - Akron
Green, W. J., Agricultural Experiment Station, - Wooster

Hancock, W. J., Yellow Springs
Hard, M. E., Bowling Green
Hart, Mary E., The Western College, - - - Oxford
Hartzell, J. C., Johns Hopkins, Baltimore, Md.
Hartzler, J. C., 67 North Sixth St., Newark
Hayes, Seth, - - Fremont
Herrick, C. Judson, Granville
Herzer, Rev. H., 438 South Third St., - - - Columbus
Hill, Calvin J., - - Akron
Hill, W. M., - East Liverpool
Hine, J. P., - - Shinrock
Hine, Prof. J. S., - Columbus
Hobbs, P. L., - - Cleveland
Holferty, Prof. G. M., Cincinnati
Hope, Henry W., - . - Paint
Hopkins, A. D., Morgantown, W. Va.
James, Davis L., 127 West Seventh St., - - - Cincinnati
Janney, John J., 93 Fifteenth Ave., Columbus
Johnson, Eva V., - Granville
Jones, E. A., 138 East Tremont St., - - - Massillon
Jones, Lynds, College Museum, Oberlin
Judson, C. A., 235 Columbus Ave., Sandusky
Kellerman, Karl F., 175 W. 11th Ave., - - - Columbus
Kellerman, Prof. William A., 175 West Eleventh Ave., Columbus
Kellerman, Mrs. W. A., 175 W. 11 Avenue, Columbus
Kellicott, W. E., 1332 Highland St., - - - Columbus
Kelsey, Rev. F. D., 2146 Fulton St., - - - - Toledo
Keyser, I. N., - - London
Krebs, Carl, 1223 Cedar Ave., Cleveland
Kurtz, Prof. O. W., - Minerva
Lambert, J. I., 452 South Broadway, - - - Dayton
Landacre, F. L., O. S. U., Columbus
Law, Mary E., 2313 Ashland St., Toledo
Lazenby, Prof. William R., 311 W. Sixth Ave., - Columbus
Lindahl, Dr. Josua, 312 Broadway, - - Cincinnati
Line, Carrie E., Jacksonville, Ill.
Lloyd, John Uri, Court and Plum Sts., - - Cincinnati
Luke, Fred K., O. S. U., Columbus
Mally, C. W., 59 East Liberty St., Wooster
Mann, Prof. Albert, Delaware
Mason, Harriet, - Wellington
Masterman, E. E.. New London
Mateer, Dr. H. N., - Wooster
Mathews, Mary E., Painesville
McComb, E. H. K., 227 West Galen St., - - Bucyrus
McCoy, C. T., 317 East Mulberry St., - - - Lancaster
McFadden, Prof. L. H., Westerville
McGregor, J. H., - Bellaire
Mertz, H. N., - Steubenville
Mills, W. C., O. S. U., Columbus
Morehead, Prof. Warren K., Saranac Lake, New York
Morrison, F. E., - Kingsville
Moseley, Prof. E. E., Sandusky
Mulloy, Rose, - Columbus
Negley, Miss Poyntz A., Dayton
Oberholser, H. C., 1505 Howard Ave., - Washington, D. C.
Orton, Dr. Edward, 100 Twentieth St., - - - Columbus
Osborn, Herbert, O. S. U., Columbus
Osburn, Raymond C., Columbus
Outhwaite, Hon. Joseph H., Columbus
Parker, J. Bernard. - Danville
Phillips, E. W., - Circleville
Piwanka, Thomas, 243 Superior St., - - - Cleveland

Postle, Herman, - Sandusky
Prather, John M., Yellow Springs
Ravenscroft, Lillian E. Dayton
Rhodes, Thomas, - - Akron
Richards, E. E., 24 E. Church St., Newark
Ricketts, Dr. B. Merrill, 415 Broadway, - - Cincinnati
Riddle, Lumina C., 1319 Wesley Ave., - - - Columbus
Royer, John S., - Versailles
Sanger, U. G, - - St. Marys
Sanor, S. D., - East Liverpool
Sarver, Prof. John M., Canton
Sawyer, Prof. Mary A., The Western College - - Oxford
Schaat, William G., - Berea
Schaffner, John H., Ohio State University, - Columbus
Schumacher, F., 1347 Monadnack Building, - - Chicago
Schuyler, P. N., - - Bellevue
Scott, Daisy M., 1274 Summit St., Columbus
Selby, A. D., Botanist and Chemist, Agricultural Experiment Station, - - Wooster
Shannon, T. N., Wilmore, Ky.
Shull, Geo. H., Yellow Springs
Simkins, J. D., - St. Marys
Slocum, Dr. C. E., - Defiance
Smith, H. E., - - Marietta
Smith, Prof. James H., - Berea
Soule, Prof. William, 1804 S. Union Ave., - - - Alliance
Stair, Leslie Dalrymyple, 1180 East Madison St., Cleveland
Stearns, C. H., - - Athens
Sterki, Dr. Victor, N. Philadelphia
Stevens, F. Lincoln, 1418 Neil Avenue, - - Columbus
Stone, John A., - Marietta
Tight, Prof. W. G., - Granville
Todd, Dr. Joseph H., Christmas Knoll, - - - Wooster
Treadwell, Prof. Aaron L., Oxford
Tussing, P. I., - - - Ada
True, Dr. H. C., McConnellsville
Upson, Judge W. H., - Akron
Vickers, Ernest W., - Ellsworth
Vorce, Charles M., 5 Rouse Block Cleveland
Walker, Dr. Faye, - Oxford
Warder, R. H., - North Bend
Warner, Prof. E. F., 480 W. Main St., - - - Bellevue
Watson, J. R., - - Berea
Webb, R. J., - Garrettsville
Weber, Prof. Henry A., 1342 Forsythe Ave., - Columbus
Webster, F. M., Entomologist, Agricultural Experiment Station, - - Wooster
Werner, William C., Painesville
Werthner, William, Steele High School, - - - Dayton
Werum, J. H., 508 Adams, Toledo
Williamson, C. W., Wapakoneta
Williamson, E. Bruce, Bluffton, Ind
Winchet, Frances, 346 N. First Ave., - - - Dayton
Wright, Prof. G. Frederick, Oberlin
Wright, Prof. Albert A., 123 Forest St., - - Oberlin
Wright, Prof. John B., Wilmington
Young, W. U., - St. Marys

Deceased.

David S. Kellicott, Columbus
Acton F. Hawn, - - Akron
Gen., M. F. Force, - Sandusky

SEVENTH ANNUAL REPORT

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WINTER MEETING.

The eight annual meeting was held at Columbus, December 29th and 30th, 1898, Thursday's sessions in Orton Hall, Friday's in the new Zoological Hall.

The secretary reported the deaths of D. S. Kellicott, H. L. Jones and Henry Snyder; the removal to California of E. W. Claypole and the absence from the State on account of impaired health of A. A. Wright. G. F. Wright commented on the work at Oberlin of H. L. Jones and his untimely death, and said that they hoped A. A. Wright would be able to resume his duties after the holidays.

The report of the acting treasurer, James S. Hine, was read, showing a balance of $81.62.

The committee on courses of study reported that it had not been able, as yet, to accomplish much, finding problem exceedingly difficult, and suggested that a new committee be appointed. The Academy voted to accept the report, discharge the committee and authorize the president to appoint another committee whose report should come as a regular paper on the program of the next winter meeting. Later the president appointed the following committee on science teaching in the public schools: W. A. Kellerman, Mary E. Law, Wm. Werthner, J. A. Bownocker, C. J. Herrick.

Professor Kellerman reported for the committee appointed, to secure legislation with reference to game laws that he framed a bill thought to embody the ideas of the members of the Academy interested. The bill was, at first, loaded down with amendments and defeated, but brought up again and passed without a single change. A number of persons have taken out permits in accordance with the provisions of the new law. The fines for violation are very heavy and from time to time have been imposed. Several members spoke regarding the desirability of protection of birds and eggs, and the consequent importance of enforcing the law. The report was accepted and the committee discharged.

The report of the committee on topographic survey was read and accepted as a report of progress and the committee continued. The Academy further voted thanks to the committee for its efforts in behalf of the bill. Professor Tight said that Professor A. A. Wright deserved most of the thanks.

Report of the Committee on a Topographic Survey of the State.

At the annual meeting of the Academy two years ago, a committee of three was appointed to secure, if possible, the inauguration of a topographic survey of the State, and the publication of its results in a series of topographic map sheets. The plan proposed was

that of co-operation on the part of the State with the topographic division of the United States Geological Survey, the State meeting one-half the expense of the field work involved, while the National Geological Survey met the other half, together with the entire expense of engraving and publication.

Your committee put forth its best efforts to present the matter to the last legislature in a practical and urgent form. A bill providing for such co-operation was introduced in the Senate by Senator Garfield, who took a warm interest in the matter, and whose aid in its management was invaluable. Hearings were granted by the appropriate committees in both Senate and House. At these hearings the committee had the valuable personal co-operation of Professor Edward Orton, our State geologist, of President Canfield and Professor C. N. Brown of the State University, of Mr. Griggs, the city engineer of Columbus, besides letters from other eminent engineers, educators and scientists of the State. Upon two of these occasions Mr. Herbert M. Wilson, chief topographer of the U. S. Geological Survey, came from Washington, at our solicitation and with the approval of the director, to explain more fully the nature of the survey, and to guarantee the good faith of the United States Survey in the matter of co-operation.

At several stages of the progress of the bill circulars explanatory of various aspects of the subject were sent to all the members of the legislature. The endorsement of various associations in the State were brought to their notice, such as the Association of College Presidents, the Society of Civil Engineers and Surveysors, and the League of American Wheelmen. The members of this Academy and of several other organizations were solicited, through their secretaries, to write favorably to their representatives in the legislature upon the subject. Sample map sheets, showing

work completed in other States, were sent from Washington at our request, to all the members.

Your committee spent as much time as was at their command in personal interviews with members and with prominent officials of the State, but it was impossible to reach a large majority in this way.

The bill, as most members of the Academy are already aware, passed the Senate, but was still in the hands of the House finance committee when the legislature adjourned. The difficulty most commonly expressed was that the asylums and public institutions required a specially large appropriation at that session. The committee found themselves forced into a discussion of the question whether it is wise for the State to lavish its money upon that class of the population who are unable to take care of themselves, to the exclusion of a measure which benefits every square mile of land in the State, and which furnishes knowledge that will stimulate enterprise and research in numerous different directions.

It was perhaps too much to expect that a measure calling for the expenditure of so considerable a sum of money should be adopted upon the first presentation. It is also evident that neither the officials nor the intelligent people of the State are as yet sufficiently informed concerning the value of such maps, to make the demand for them urgent. But wherever the matter is adequately presented, appreciation rapidly grows. Your committee has labored assiduously, and is disappointed in not being able to report success.

In behalf of the committee,

A. A. WRIGHT, Chairman.

Other members of the committee,

W. G. TIGHT,
A. D. SELBY.

December 26, 1898.

At the Thursday afternoon session, Professor Kellerman read the report of the committee appointed at the field meeting to draft a suitable memorial of David S. Kellicott. The Academy voted to have the report recorded in the minutes and a copy sent to Mrs. Kellicott.

The Ohio State Academy of Science sustained the loss of one of its most active and important members by the death of Professor David S. Kellicott, which occurred April 13, 1898. He assisted in organizing the Academy, was one of the charter members, and contributed very largely to its present stage of developement. He was an invariable attendant at both the annual and field meetings, and it was his regular and important contributions as well as his zeal and quiet enthusiasm that determined in a high degree, the success of the Academy.

His work here as well as his whole life was an inspiration to all of his associates, and especially to young students, for whom he dealt out in abundant measure his untiring energy.

Though only in the meridian of life, the work that he accomplished as a teacher and investigator has placed him in the high rank of scientific eminence. His latest contribution to the Academy was a Monograph of the Odonata, a work of the highest value which reflects great credit on both the author and the Academy.

He was the fourth president of this association and was holding the office of treasurer at the time of his death. In every capacity he was energetic, faithful, and successful.

But it is chiefly the ennobling influence of a devoted life, of generous impulses and good deeds, that leads us to place on our minutes this meagre tribute to his memory.

Professor Lazenby reported that Emerson E. McMillin had offered $250 to the trustees of the Academy to be expended in such ways as they thought best suited to promote scientific research, and had said that such a sum might be given annually, provided the use made of the money were satisfactory and it proved to be convenient for the donor to spare it. Professor Lazenby offered the following amendment to Article IV of the constitution:

"There shall be a Board of Trustees consisting of three members; one elected for one year, one for two

years, and one for three years. It shall be the duty of this board of trustees to act as the custodian of all property of the Academy and to administer all funds received for original research and investigation."

This proposed amendment will be voted on at the next annual meeting.

The Academy voted to accept the money offered by Mr. McMillin, and to appoint a committee of three to bring in a resolution the next morning relative to trustees for administering the fund. In accordance with the report of this committee, the Academy proceeded to ballot for three trustees to administer the fund for the term of one year. F. M. Webster, W. R. Lazenzy and E. L Moseley were elected trustees.

A motion to head the "Special Papers" to be published by the Academy with the words, "Memoir 1, 2, etc." was debated and lost.

The sentiment of the Academy in favor of holding the next field meeting at Columbus, in connection with the meeting there of the American Association for the Advancement of Science, as suggested by the president, was expressed by vote.

Eighteen new members were elected.

The president's address,—Geographical teaching and the Geography of Ohio was given in Orton Hall, Thursday evening.

PAPERS READ:

1. A deep pre-glacial Channel in western Ohio and eastern Indiana, - - - - - - - - - - - - *J. A. Bownocker.*
2. Some recently discovered pre-glacial cols in Ohio, *W. G. Tight.*
3. Some observations on the pre-glacial drainage of Wayne and associate counties, - - - - - - - - *J. H. Todd*
4. Some observations of the topography of Athens and vicinity, - - - - - - *H. E. Chapin & C. H. Stearns.*
5. A galenite geode from Muskingum county, - *W. G. Tight.*
6. A pocket instrument for the approximate determination of distance by triangulation, - - - - - *W.G. Tight.*

7. A descriptive list of the fishes of the big Jelloway Creek system, - - *J. B. Parker, E. B. Williamson & R. C. Osburn.*
8. Additional notes on the fishes of Franklin County, - - - - - - - *R. C. Osburn & E. B. Williamson.*
9. Notes on Ohio Astacidæ, - - - - - *E. B. Williamson.*
10. A Bat new to Ohio, - - - - - *John F. Cunningham.*
11. The Black-capped Petrel on the Ohio River, *Josua Lindahl.*
12. A rare salamander, - - - - - - - *Josua Lindahl.*
13. Additions to Ohio list of dragon flies, - - - *J. S. Hine.*
14. Additions to Ohio list of butter flies , - - - *J. S. Hine.*
15. Twenty-five species of Syrphidæ not previously reported for Ohio, - - - - - - - - - - - - *J. S. Hine.*
16. Remarks on the Hemipterous fauna of Ohio with a preliminary record of species, - - - - - - - *Herbert Osborn.*
17. A contribution to the knowledge of the faunistic entomology of Ohio, - - - - - - - - - - *F. M. Webster.*
18. Some notes on the grape cane gall maker, Ampeloglypter sesostris, - - - - - - - - - - *F. M. Webster.*
19. Some apparent relations of Ants to peach aphis, A. persicæ-niger, - - - - - - - - - - - - *F. M. Webster.*
20. A female of the Purslane Sawfly, Schizocerus Sp., with a male antenna, - - - - - - - - - - *C. W. Mally.*
21. Some observations on Unio subovatus - *F. L. Landacre.*
22. The division of the macrospore nucleus of Erythroninm, - - - - - - - - - - - *John. H. Schaffner.*
23. Development of the micro sporangium of Hemerocallis fulva, - - - - - - - - - - - - - *E. L. Fullmer.*
24. Further studies in Embryology, - - *Miss L. C. Riddle.*
25. Notes on fasciation, - - - - - *Miss L. C. Riddle.*
26. Nutation of the cultivated Sun flower, *John H. Schaffner.*
27. Notes on ecological plant geography of Summit, Wayne & Medina Counties, - - - - - - - - - *A. D. Selby.*
28. Field notes, - - - - - - - - - - *A. D. Selby.*
29. Some sources of the Ohio flora, *A. D. Selby & J. W. T, Duvel.*
30. Observations on the Ohio flora, - - *W. A. Kellerman.*
31. Plants new to the Ohio catalogue, - - *W. A. Kellerman.*
32. List of phenogams new to Ohio or rare in and new to counties of northern Ohio, - - - - - - - - *Edo Claassen.*
33. Some rare Ohio plants, - - - - - - *E. L. Moseley.*
34. Two interesting filamentous barteria from Columbus, - - - - - - - - - - - - *John H. Schaffner.*
35. Studies of Ustilago reiliana, - *W. A. & K. F. Kellerman.*
36. Lists of Erysipheæ and Uredineæ of Cuyahoga and other counties of northern Ohio, - - - - *Edo Claasse n*

37. Second list of the liverworts of Cuyahoga and other counties of northern Ohio, - - - - - - - *Edo Claassen.*
38. Reliability of spore measurements of the fleshy fungi, - - - - - - - - - - - - *H. C. Beardslee.*
39. Micro-photographs of fungus spores, - - *A. D. Selby.*
40. Distribution of the microscopic fungi, - *H. C. Beardslee.*
41. The waste or refuse in fruits and nuts, - *W R. Lazenby.*
42. Some abnormal plant specimens, - - *Miss L. C. Riddle.*
43. A curious lightning stroke, - - - - - *J. J. Janney.*
44. The laboratory and the field; their relative importance, - - - - - - - - - - - - - *H. E. Chapin.*
45. The Illinois Biological Station, - - *H. C. Beardslee.*
46. A plea for science teaching in the public schools, - - - - - - - - - *Miss Mary E. Law.*
47. Climate of the Philippine Islands, - - - *E. L. Moseley.*
48. Life in the Philippines, - - - - - *E. L. Moseley.*

FIELD MEETING.

The Academy met at Dayton, June 3 and 4, 1898. Friday morning some of the members visited the Soldiers' Home, and others the High School. In the afternoon Dr. Foerste conducted an excursion to the glacial region south of Dayton where numerous kames and kettleholes were examined.

Friday evening the Academy met at the Steele High School and enjoyed an illustrated lecture on glaciers by Dr. August F. Foerste. Following this was a business meeting at which nine persons were elected to membership. Professor Kellerman said that the committee

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The members present voted to extend their sincere thanks to Dr. August F. Foerste for his admirable lecture, to John Patterson for furnishing the stereopticon and to Professor Werthner, and the others who had helped to make the meeting so pleasant. After the meeting refreshments were served by the Dayton teachers.

Saturday morning an excursion was made to Yellow Springs and thence to Clifton where the Little Miami has cut a remarkably narrow gorge through Upper Silurian limestone. This trip seemed to be enjoyed by everyone, and a number of interesting points pertaining to different branches of science were acquired by each member, not only by association with others, but by viewing nature in a new region. A good lunch was served at the "Picnic Grounds" by the Dayton teachers. Several professors and students of Antioch College assisted materially to make the trip instructive and pleasant.

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A DESCRIPTIVE LIST OF THE FISHES OF BIG JELLOWAY CREEK AND TRIBUTARIES, KNOX COUNTY, OHIO.

By J. B. Parker, E. B. Williamson and R. C. Osburn.

Big Jelloway Creek is located in the northeastern part of Knox County, Ohio, and is a part of the Muskingum system. It is about twenty miles in length, and its general direction is south. Throughout its course the bottom varies between gravel and mud, except in the last few miles, where sandstone appears. The stream is a succession of quiet pools and short, rapid flowing ripples. The tributaries, which have the general characteristics of the main stream, are Little Jelloway, Black's Run, Sawmill Run, Parker's Run, Joe Sapp Run, Doudy Creek and Shadley Run.

The region drained by these streams, an area of about one hundred square miles, is hilly and abounds in clear, cold springs. Owing to this fact, it is only in seasons of long continued drought that the water in the streams shows any appearance of stagnation. The removal of the forests has rendered these streams subject to violent and destructive freshets, which continually shift the banks and bottoms of the streams.

Unfortunately, the time chosen for the investigation was most unfavorable for the best results. Unusual changes had been wrought in the general character of the streams by the unusually high floods of the preceding months. The streams were filled with roots, drift wood and rubbish of all sorts; new channels and ripples had been formed, and the old feeding and spawning places of the fishes were changed or gone. Then,

too, the streams were still swollen and turbid when the seining was being done.

The period of investigation extended from May 23 to May 31, 1898, inclusive. The equipment necessary for carrying on the work was furnished by the Zoological Department of the Ohio State University, and specimens of every species included in this list have been placed in the Zoological Museum of this University. Owing to the time of the year at which the collecting was done, many species were taken in breeding coloration; and, unless otherwise stated, the color descriptions apply to the brightest and most highly colored males.

Each day, temperatures were taken at six o'clock, morning and evening, from May 23 to May 31, inclusive, to determine the temperature of the water relative to that of the air. Parker's Run was taken as fairly typical of the smaller tributaries of Big Jelloway, and its average temperature was found to be, within a very small fraction, the same as that of the air; while the temperature of Big Jelloway averaged 4° warmer. The "brook" Cyprinidæ (Chrosomus erythrogaster, Rhinichtys atronasus, Leuciscus elongatus, etc.) were breeding in water with a temperature below 60°, while the "river" species (Hybopsis amblops, H. kentuckiensis, Notropis cornutus, etc.,) were breeding at a temperature of about 64°. The following table shows the results of our observations on temperature.

			A. M.	P. M.
Average	temperature	of air	55 6-7°	62 6-7°
"	"	of Big Jelloway	60 ¼°	67 1-7°
"	"	of Parker's Run	54 7-8°	63 6-7°
Maximum	"	of air	58°	72°
"	"	of Big Jelloway	62°	70°
"	"	of Parker's Run	57°	66°
Minimum	"	of air	52°	56°
"	"	of Big Jelloway	58°	64°
"	"	of Parker's Run	52°	62°

In addition to the list of fishes, lists of Astacidæ, Unionidæ, Bacrachia and Reptilia are included. Of these, special attention was given only to the Unionidæ, the species being determined by Mr. Chas. T. Simpson of the U. S. National Museum. The general conditions of the streams are unfavorable to this form of life, owing to the shifting nature of the banks and bottoms and the absence of exposed limestone formations. Of the Astacidæ, specimens of Cambarus bartonii robusta Girard were identified by Mr. Walter Faxon, Of the different groups the following number of species of each was taken: Astacidæ 3, Unionidæ 9, Fishes 36, Batrachia 9, Reptilia 8.

ASTACIDAE.

1. Cambarus bartonii robusta Girard.
2. " propinquus sanbornii Faxon.
3. " diogenes Girard.

UNIONIDAE.

1. Unio luteolus Lamarck.
2. " pressus Lea.
3. " ventricosus Barnes.
4. " ligamentinus Lamarck.
5. " gibbosus Barnes.
6. Margaritana rugosa Barnes.
7. " calceola Lea.
8. Anodonta ferussaciana Lea.
9. " edentula Say.

BATRACHIA.

1. Necturus maculatus Rafinesque.
2. Bufo lentiginosus americanus (LeConte).
3. Acris gryllus crepitans Baird.
4. Hyla versicolor LeConte.
5. Rana virescens Kalm.
6. " sylvatica LeConte.

7. " clamata Daudin.
8. " catesbiana Shaw.

REPTILIA.

1. Thamnophis sirtalis (Linnaeus).
2. Regina leberis (Linnaeus).
3. Tropidonotus sipedon (Linnaeus).
4. Bascanion constrictor (Linnaeus).
5. Sceloporus undulatus (Daudin).
6. Aspidonectes spinifer (LeSueur).
7. Chelydra serpentina (Linnaeus).
8. Chrysemis marginata (Agassiz).

LIST OF FISHES.

MARSIPOBRANCHII *

1. *Ichthyomyzon concolor* (Kirtland). Of this species only larval forms were taken. One large larva, seven inches in length, showed the following colors: dull yellow, pigmented above with fine brown specks, giving to the back a brownish cast; this is interrupted in the mid-dorsal line, leaving a yellow vertebral line; fins yellowish, brightest at base. Young larvæ, two and one half inches long, were light olive brown, with fine brown specks above; dark around base of anal fin. Eyes very slightly developed. The young larvæ were taken from a mass of sand and mud seined from the bottom of Sawmill Run.

On October 3, 1898, in Big Jelloway Creek, Mr. J. D. Parker took a large Black Bass upon which were found two small lampreys, presumably of this species,

*Our larval lampreys were identified by Dr. B. W. Evermann, to whom we are also indebted for many helpful suggestions.

between two and three inches in length. These were firmly attached, one on either side of the body, just in front of the caudal fin.

2. *Lampetra wilderi* Gage. Color above, uniform blue-black ; below rather abruptly silvery ; fins plain, light in color. At the time when the seining was done none of this species were taken ; but a few weeks earlier, about the middle of April, they were observed by Mr. J. D. Parker to be common on the ripples of the smaller streams. Four specimens were taken on one ripple at one dip of an insect net.

PISCES.

3. *Ameiurus melas* (Rafinesque). Head 3½ ; depth 3½ ; eye 7 ; A. 17 or 18. Color, black above, white or yellowish below ; barbels all dark. Rare in Big Jelloway ; but an old creek bed, now a muddy, brushy pond at some distance from the creek contained great numbers of them.

4. *Noturus flavus* Rafinesque. Head 4; depth 5; eye 7. Yellowish olive ; pale below. Not common ; taken only in Big Jelloway.

5. *Catostomus commersonii* (Lacepede). Head 3¾ to 4¼ ; depth 4½ to 5 ; eye 5½ to 6 ; scales 10 or 11 -65 to 68-7. Above, olive green, irregularly mottled with black ; below, silvery ; fins all plain, the caudal and lower fins tinged with orange. Common ; taken in all streams.

6. *Catostomus nigricans* LeSueur. Head 4; depth 5 to 5½ ; eye 5 to 5½; scales 7-50 ; D. 11 ; A. 7. Above, pale olivaceous with a brassy luster, with about five oblique irregular dark cross-bars ; below, white ; fins all plain, the lower tinged with dull orange ; anal and lower part of caudal fin tuberculate. Taken in all the streams ; especially common in the larger streams on swift ripples.

7. *Moxostoma aureolum* (LeSueur). Head 4 to 5; depth 4 to 5; eye 4½ to 5; D. 13 or 14, sometimes 12, rarely 15; scales 6 or 7–43 to 49–5. Above, olive with brassy luster; below, silvery; fins all plain, the lower ones orange; nose, anal fin, and lower part of caudal fin tuberculate. Abundant; the young fry ascending even the smallest brooks. Taken with eggs on May 26, 1898.

8. *Campostoma anomalum* (Rafinesque). Head 4; depth 4 2–5; eye 5. D. 8; A. 7; scales 7–48–6; teeth 4–4. Back brownish, sometimes almost black; sides brassy, irregularly mottled with black; sometimes head and sides below, rosy; young with a dark loteral stripe extending onto the gill covers and between eye and snout; entire dorsum prickly in the breeding males. Dorsal fin tinged with orange, a black bar through its middle; caudal and pectorals slightly, and anal and ventrals heavily pigmented with orange, especially near their bases; ventrals and pectorals with black at their bases; caudal with a triangular black spot near its base. Length six inches. Apparently the most abundant species of fish in the Big Jelloway System.

9. *Chrosomus erythrogaster* Rafinesque. Head 4; depth 4; eye 3½. D. 8; A. 8; teeth 5–5. Above, brown with numerous narrow brassy cross-bars; an interrupted, black vertebral line which has near it on each side an irregular row of black dots; sides creamy white, bordered above and below with a black band, the lower the broader and extending through the eye, which is yellow, and ending posteriorly in a caudal spot; under parts white, in breeding males entirely suffused with vermillion. Fins all bright sulphur yellow, the dorsal with a bright red spot at its base anteriorly; females less brilliantly colored. Length two inches. Taken only in Parker's Run, where it

occurs in considerable numbers. Females with eggs were observed on May 25.

10. *Pimephales promelas* Rafinesque. Head 4; depth 3¾; eye 4. D. 1, 7; A. 7; scales 8–44–5; teeth 4-4. Color, dark olive. each scale with a dusky edge; paler below; a dark lateral band and caudal spot; head dark, with tubercles on snout and lower jaw. Dorsal fin with a dusky bar through it; other fins all plain. Length two and one eighth inches. Rare; a specimen from a mere puddle near Big Jelloway, and another from Doudy Creek were the only ones taken.

11 *Pimephales notatus* (Rafinesque). Head 4½; depth 4½; eye 4¼; D. S, 8; A. 7; scales 6–45–4; teeth 4–4. Above, dark olive brown, each scale black edged; sides and belly paler; a black speck above and below each pore of the lateral line; head black. Dorsal fin with an anterior black spot on its middle, and with the rays posteriorly dark; other fins paler; rays dark tinged. Head with sixteen tubercles. Length three and one half inches, Abundant in every stream. Females with ripe eggs on May 23, 25 and 26.

12 *Semotilus atromaculatus* (Mitchill). Head 3¾; depth 4; eye 5½. D. 8; A. 8; scales 9–55 to 60–6; teeth 2, 5–4, 2. Dark olive above, paler below; sides with a brassy luster; an indistinct lateral band and caudal spot, and an indistinct stripe along side of head, through eye, (these markings distinct in young specimens); tip of snout black. Caudal and lower fins tinged with organge; sometimes sides of head and lower fins rosy; dorsal with a black spot at its base, confined to the membranes of the four anterior rays of the fin. Length seven inches. Common or abundant.

13, *Leuciscus elongatus* (Kirtland). Head 3 4–5; depth 5; eye 4⅓. D. 8; A. 9; teeth 2, 5–4, 2. Color, above, grass green; a dark vertebral line; the green bordered below by a narrow brassy band; below this is a broad band which is bright blood red anteriorly,

cles on top and sides. A few specimens from Big Jelloway Creek have a dark band between the brassy lateral band had the vertebral line. These specimens were about four inches long and were the most brilliant colored ones observed. Length seven and three fourths inches. Abundant in every stream. Females, varying in length from two to five inches were observed with eggs on May 23, 25 and 26.

18. *Notropis atherinoides* Rafinesque. Head 4½; depth 5½; eye 3⅓. D.8; A.10; scales 5—40—3; teeth 2,4—4,2. Above, clear translucent olive green; a yellow iridescent vertebral line, and mottlings of the same color on the head; sides silvery with a brassy lateral band; lips black; fins plain. Length four inches. Abundant in Big Jelloway.

19. *Notropis rubrifrons* (Cope). Head 4; depth 5; eye 3½. D.8; A.10; scales 5—40—3; teeth 2,4—4,2. Above, clear olive, each scale with a dark edge; sides and under parts silvery; a narrow coppery lateral stripe, overlying dark pigment. In breeding males the head, thoracic region, and bases of the dorsal, ventral and pectoral fins are bright blood red. Length two and three fourths inches. Occasionally observed in large schools over clean gravelly places in ripples. Females with ripe eggs on May 23.

20. *Ericymba buccata* Cope. Head 3½; depth 4½; eye 3½. D. 8; A. 8; scales 4—36—3; teeth 1. 4—4, 1, sometimes 1, 4—4, 0. Above, light translucent olive, each scale edged with dark; a dark vetebral line; sides silvery, with a brassy lateral band. Fins all plain. Length three and one-fourth inches. Abundant; taken in every stream. Females with eggs on May 24.

21. *Rhinichthys atronasus* (Mitchill). Head 3 4-5; depth 4½; eye 4½; D. 8; A. 7; scales 10—66—6; teeth 2, 4—4, 2. Above, dark yellowish olive, much blotched with black; a wide, bright orange lateral

band from opercle to base of caudal fin; this band usually mottled with black; belly silvery; a black stripe forward from the eye. Fins plain; the dorsal with a low black spot at its base; pectorals tinged with yellow. Top and sides of head, and the inner surface of the ventral fins covered with very small prickles. Length two and three-fourths inches. Common and abundant in those streams in which it occurs. Females taken with eggs on May 24.

22. *Hybopsis amblops* (Rafinesque). Head 4; depth 4½; eye 3. D. 8; A. 7; scales 5—38—4; teeth 1, 4—4, 1. Above, translucent green, each scale with a dark edge; below, silvery; sides with a silvery lateral band. Fins all plain. Length three inches. Abundant in Big Jelloway. Females with ripe eggs May 26.

23. *Hybopsis kentuckiensis* (Rafinesque). Head 3¾; depth 4; eye 5¼. D. 8; A. 7; scales 6—41—5; teeth 1, 4—4, 1. Dark olive green above, paler below; sometimes with a brassy luster; occasionally with a clear grass-green lateral band; frequently with a blood red spot, than the eye, just behind the eye in front of the operculars; dark caudal spot in smaller specimens; breeding males had about thirty-five tubercles. One male had the top of the head swollen into a crest. Fins plain, tinged with a dull orange and greenish. Length five and one-half inches. Abundant. Females with ripe eggs taken on May 23 and 25.

24. *Cyprinus carpio* Linnæus. Head 3½; depth 3; eye 6. D. I. 19; A. I. 5; scales 6—38—7; teeth 1, 3—3, 1. Dark olivaceous with brassy luster, each scale with a dark spot at its center; below, pale; fins all plain. Only the "full scale" variety was observed, and this was very common. Specimens fifteen inches in length were taken.

25. *Ambloplites rupestris* (Rafinesque). Head 2¾; depths 2½; eye 4. D. XI, 10 or 11; A. VI, 10; scales 8–40–12. Color, olive green, much mottled with black; sometimes a decided yellow color; usually each scale with a large center, forming interrupted longitudinal lines; a large black spot on the opercles. Dorsal, caudal and anal fins mottled with black, forming irregular bars; pectorals and ventrals plain. Length seven inches. Not common. Females with eggs on May 26.

26. *Apomotis cyanellus* (Rafinesque). Head 3; depth 2½; eye 4. D. X, 11 or 12; A. III, 9 or 10; scales 8–46–16. Back and sides olive and grass green, with longitudinal rows ot blue dots formed by a spot on each scale; below, yellowish; opercular flap black, bordered with golden green; cheeks with two irregular blue strips and many blue spots. Pectorals plain; all the other fins mottled with yellowish green and margine, with silvery; the ventrals more yellow; a black spot on the posterior rays of the dorsal. Very young specimens are barred with blue. Length four and one-half inches. Taken only in larger streams; rare. A female one and three fourths inches long, taken May 28, contained ripe eggs.

27. *Micropterus dolomieu* Lacepede. Head 3; depth 3½; eye 5½. D. X, 13 or 14; A. III, 10; scales 11–75–15. Adult, yellowish green above, white below. Yonng, above olive, with golden brown blotches; fading out into white on the belly; the sides with many small blotches and specks of golden brown; cheeks and opercles with three longitudinal stripes of the same color. Soft dorsal with two irregular brown bands; caudal with a vertical black band; other fins plain. Abundant in some places; the largest one taken weighed about one pound.

28. *Percina carpiodes* (Rafinesque). Head 3¾; depth 6; eye 5; scales about ninety in the lateral line;

D. XV–15; A. II–10 to 12. Above, light olive, sometimes yellowish, with about ten dark, vertical bars reaching below the lateral line and alternating with the same number of shorter dark bars; belly, pale. Dorsal and caudal fins blotched and barred with dusky; lower fins plain, tinged with yellowish. Common; usually taken in quiet water.

29. *Hadropterus aspro* (Cope and Jordan). Head 3½ to 4; depth about 6; eye 4½; scales 7–65–9; D. XIV–13; A. II, 9. Above, dark olive and light yellowish, much tesselated; about eight elongated black blotches along the lateral line, these sometimes confluent forming an irregular latteral band; below, white; dorsal and caudal fins more or less pigmented with black; lower fins pale. Common.

30. *Diplesion blennioides* (Rafinesque). Head 4¼; depth 5½; eye 3½; D. XIII–13; A. II, 8; scales 6–60 to 65–7. Above, bright olive green, irregularly crosssbarred with darker green; about eight Y-shaped green blotches on the sides; numerous brown spots on back and sides; first dorsal tinged with coppery green, its base bright orange; second dorsal caudal speckled with orange and indigo; anal and ventrals coppery green; pectorals tinged with orange. Common on ripples, especially in the larger streams.

31. *Boleosoma nigrum* (Rafinesque). Head 4; depth 5½ to 5; eye 4. D. IX–11 or 12. A. I, 8; scales in lateral line 47. Color, dark olive brown, paler below; about nine irregular w-shaped blotches along the sides; scales of dorsum more or less heavily edged with black. Abundant in all streams, occurring usually in quiet shallow pools.

. 32. *Etheostoma variatum* Kirtland. Head 3½; depth 5; eye 3½; D. XII–13; A. II, 9 or 10; scales in the lateral line 52. Color, dark olive, with about eight greenish cross-bars on posterior part of body; interspaces pale, each with two bright carmine spots; back

crossed by four black bars; sides of belly bright orange; middle of belly pale; first dorsal dark brown at base, then a pale space, above this a wide dark bar, then another pale space, bordered with bright orange; second dorsal and caudal flecked with carmine; anal greenish, bordered with pale orange; ventrals greenish black with a little orange at the margin; pectorals tinged with orange and green, the rays with carmine spots. The most abundant darter, especially frequenting swift ripples in the larger streams,

33. *Etheostoma zonale* (Cope). Head 4; depth 5; D. XI-12; A. 11, 7; scales 5-48-7. Color, above, olive; below, paler with brassy tinge; about twelve copperas green bands, all but the most anterior ones encircling the body; breast greenish black; first dorsal black at base, then a wide orange bar, the margin black anteriorly, greenish posteriorly; second dorsal orange at base, above this dark, fading out toward the edge; caudal and pectorals plain, tinged with green; anal and ventrals green, black at base. Common on swift ripples.

34. *Etheostoma coeruleum* (Storer). Head 3½; depth 4¼; D. IX or X-12 to 14; A. II, 6 or 7; scales 5-48-7. Color, dark olive brown; cheeks blue-green; throat and lower jaw, orange; sides with about eleven green cross-bars, the interspaces posteriorly being orange; first dorsal fin orange at base, the remainder of the fin blue-green; second dorsal blue at base, then a wide orange bar, edged with indigo; caudal edged with indigo, its membrane spotted and streaked with orange; anal indigo, its membranes posteriorly with orange spots; ventrals deep indigo; pectorals plain, tinged with orange at tip and with indigo at base. Very common, especially on ripples.

35. *Etheostoma flabellare* (Rafinesque). Head 3½ to 3¾; depth 5¾ to 6; eye 5; D. VIII-13 or 14; A.

21.8; scales 50 in the lateral line. Color, dark olivaceous, forming bars on the sides; below, pale; head and breast heavily pigmented with blue-black; dorsal fins black at base, orange at tip, the second dorsal somewhat crossbarred; caudal conspicuously crossbarred with black; lower fins plain, the pectorals tinged with yellow. A very common species, taken usually on ripples; noted with eggs on May 24.

36. *Cottus ictalops* (Rafinesque). Head $3\frac{1}{4}$; depth $4\frac{1}{2}$; eye 4; D. VII–16 or 17; A. 12. Color, dark brownish olive, with three irregular dark bars partially encircling the body; other dark blotches, sometimes obscure, on the sides and dorsum; first dorsal with a wide black bar, margined with orange; ventrals plain; other fins barred with dusky; below, pale; under side of head dark. Common in Black's Run; taken on ripples, especially in woodland.

		Big Jelloway Creek.	Little Jelloway Creek.	Black's Run.	Sawmill Run.	Parker's Run.	Joe Sapp Run.	Shadley Run.	Doudy Creek.
1	Ichthyomyzon concolor	o			o				
2	Lampetra wilderi	o			o	o			
3	Ameiurus melas	o							
4	Noturus flavus	o							
5	Catostomus commersonii	o	o	o	o	o	o	o	o
6	Catostomus nigricans	o	o	o	o	o	o	o	o
7	Moxostoma aureolum	o	o	o	o	o	o	o	o
8	Campostoma anomalum	o	o	o	o	o	o	o	o
9	Chrosomus erythrogaster					o			
10	Pimephales promelas	o							
11	Pimephales notatus	o	o	o	o	o	o	o	o
12	Semotilus atromaculatus	o		o	o	o	o	o	o
13	Leuciscus elongatus		o	o		o	o	o	o
14	Abramis crysoleucas	o							
15	Notropis blennius	o	o	o			o	o	o
16	Notropis whipplii	o	o	o		o	o	o	o
17	Notropis cornutus	o	o	o	o	o	o	o	o
18	Notropis atherinoides	o							
19	Notropis rubrifrons	o	o	o		o	o		
20	Ericymba buccata	o	o	o	o	o	o	o	o
21	Rhinichthys atronasus		o			o	o	o	
22	Hybopsis amblops	o	o						
23	Hybopsis kentuckiensis	o	o	o		o	o	o	o
24	Cyprinus carpio	o	o						
25	Ambloplites rupestris		o	o					o
26	Apomotis cyanellus	o	o	o					o
27	Micropterus dolomieu	o	o	o			o	o	o
28	Percina caprodes	o	o	o					
29	Hadropterus aspro	o	o			o	o		o
30	Diplesion blennioides	o	o	o	o	o	o	o	o
31	Boleosoma nigrum	o	o	o	o	o	o	o	o
32	Etheostoma variatum	o	o	o			o		
33	Etheostoma zonale	o	o	o		o			
34	Etheostoma coeruleum	o	o	o		o	o		
35	Etheostoma flabellare	o	o	o	o	o	o	o	o
36	Cottus ictalops			o		o			

ADDITIONAL NOTES ON THE FISHES OF FRANKLIN, COUNTY OHIO.

BY R. C. OSBURN AND E. B. WILLIAMSON.

In our paper on the Fishes of Franklin County, published in last year's proceedings of the Academy, (1898) we described as new, a species of *Etheostoma* under the name *sciotense*. Since that description was printed, Dr. Evermann, Ichthyologist to the U. S. Fish Commission, has compared the types of *Etheostoma sciotense* and *E. tippecanoe* Jordan and Evermann, and he writes that the two are identical, the squamation of the anterior dorsal region being the same in both, and the differences in coloration only such as may be explained by age, sex and season. *Etheostoma tippecanoe* has, so far, been recorded only from the Tippecanoe River, Indiana, and, while Dr. Evermann is doubtless correct in his decision, *tippecanoe* and *sciotense* show some interesting differences both in the arrangement and the color of markings.

Specimens of minnows, number [illegible] and [illegible], *Notropis cayuga*, *N. blennius* and *N. sp.?* have been examined by Dr. Chas H. Gilbert, and our identification of *cayuga* and *blennius* confirmed. *Notropis sp?* is *Notropis shumardi*. Our four specimens agree very well with Girard's figure of this species in Girard's "Fishes" (Part IV, Exp. and Surveys for a Railroad route from the Mississippi River to the Pacific Ocean, Washington, [illegible]), Plate LVIII, figs. 1–4.

During the spring of [illegible] the embankment confining the waters of [illegible] Lake on the [illegible] State University campus was [illegible] by a [illegible] and [illegible]

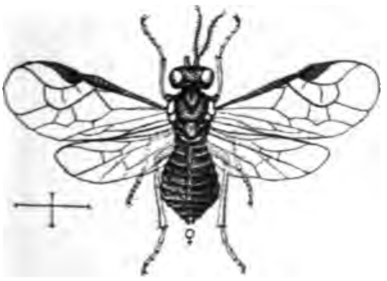
numbers of Carp, *Cyprinus carpio*, Goldfish, *Carrassius auratus*, and Tench, *Tinca tinca* escaped into the small stream which flows from the lake, and thence into the Olentangy River. In September, 1898, specimens of Tench were taken at the mouth of this small stream, so that the county list now stands at 70 species. Whether *Tinca tinca* will hold its own and multiply in the streams is a question. It belongs to the *Cyprinidæ*, the Minnow family, and superficially bears considerable resemblance to the Golden Bream, *Abramis crysoleucas*.

A FEMALE OF THE PURSLANE SAW-FLY, SCHIZOCERUS SP?, WITH A MALE ANTENNA.

By C. W. Mally.

During the summer of 1898, larvæ of this insect were observed to be mining very extensively in the leaves of purslane, and a quantity of infested leaves were placed in a breeding cage for the purpose of rearing the adults. As soon as these adults emerged, they were placed on a fresh plant in order that the method of oviposition might be observed. After watching them for some time, I noticed one female that appeared to have longer and more slender antennæ than the others, and both seemed to be placed on one side. The

specimen was at once captured and an examination revealed the fact that one antenna had apparently been broken off and the remaining one was like that of the male. The specimen seemed to be perfect in every other respect, and was observed to deposit a number of eggs after the usual manner. A large series of adults were then examined, but no other instance of this peculiarity could be found. The eggs had been deposited in the leaves with those of many other females, and, hence, no observation could be made as to the progeny of this individual. The illustration represents this specimen, showing the one antenna; whether the missing one was of the female type, or was also like that of the male, it is impossible to say, as the basal joint is alike in both sexes.



OBSERVATIONS OF THE OHIO FLORA.

By W. A. Kellerman.

(ABSTRACT.)

Bibliographical.—Many collectors have published lists of Ohio plants. The earliest of these date from a period soon after the first settlement of the State was

made at Marietta. The first list of great importance was contained in Riddell's Synoptical Flora of the Western States, followed the next year (1836) by a Supplementary Catalogue of Ohio Plants.

The first State Catalogue was published by J. S. Newberry in 1859; the second by H. C. Beardslee in 1874; and the third by Kellerman and Werner in 1893. Many important local and county lists have appeared from time to time.

The earliest specimens (collected by Menassah Cutler at Marietta) were accidently destroyed by fire. None of Riddell's specimens are known to be in existence except a small lot of about one hundred samples now in the library of Marietta College, and some in the New Orleans Academy of Science; the latter said to be in a poor state of preservation.

Newberry left no specimens to verify his list; in fact we are warranted in believing that his catalogue was largely a compilation and to some extent based on unreliable information. Dr. Beardslee made extensive collections and received material from many correspondents; a part at least of this material was subsequently placed in one of the Colleges of Northern Ohio, though no report has appeared concerning the same. The MS. from which his catalogue was published was his mere tentative list, his later and carefully prepared MS., having been lost in transmission to, or by, the parties who should have published it in Vol. IV of the Ohio Geological Survey.

The catalogue of Kellerman and Werner gave on the authority of the authors only those species that were authenticated by specimens; but it also listed all species reported, in each case citing the published authority. It is thus a record of all that had been published previous to that date. Now with perfected nomenclature and sequence of groups that accords with the present status of botanical knowledge—the anti-

quated having been by nearly all American botanists wholly discarded—and the recognized necessity of specimens to verify each epecies reported, our local and State lists can take a higher rank and be more reliable and useful.

Geographical—The State Herbarium, containing specimens of nearly all the species that occur in Ohio, and in most cases having representatives from various portions of the State, now affords data for reliable conclusions. Situated in the Province which geographical botanists call the "Appalachian" it is nevertheless a fact that the Prairie flora permits many of its representatives to invade the western half of the State.

Many European plants have been naturalized and well established in our region. Leaving such plants out of the account, we may say that very few of the species belong to the Ohio flora that have migrated from the eastern or northeastern portion of our continent. In fact it is doubtful whether such an expression can be properly used at all. The fact is, some of the plants usually designated as northern have representatives for their southern limit in our State. Many species that are southern in their range are found in the southern counties of Ohio and some have pushed far northward. A tabulation shows that fewer northern than southern plants are found in the State.

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		Big Jelloway Creek.	Little Jelloway Creek.	Black's Run.	Sawmill Run.	Parker's Run.	Joe Sapp Run.	Shadley Run.	Doudy Creek.
1	Ichthyomyzon concolor	o	....	....	o	....	....	....	....
2	Lampetra wilderi	o	....	....	o	o	....	....	....
3	Ameiurus melas	o	....	....	....	....	....	....	....
4	Noturus flavus	o	....	....	....	....	....	....	....
5	Catostomus commersonii	o	o	o	o	o	o	o	o
6	Catostomus nigricans	o	o	o	o	o	o	o	o
7	Moxostoma aureolum	o	o	o	o	o	o	o	o
8	Campostoma anomalum	o	o	o	o	o	o	o	o
9	Chrosomus erythrogaster	....	....	....	....	o	....	....	....
10	Pimephales promelas	o	....	....	....	....	....	....	....
11	Pimephales notatus	o	o	o	o	o	o	o	o
12	Semotilus atromaculatus	o	....	o	o	o	o	o	o
13	Leuciscus elongatus	....	o	o	....	o	o	o	o
14	Abramis crysoleucas	o	....	....	....	....	....	....	....
15	Notropis blennius	o	o	o	....	....	o	o	o
16	Notropis whipplii	o	o	o	....	o	o	o	o
17	Notropis cornutus	o	o	o	o	o	o	o	o
18	Notropis atherinoides	o	....	....	....	....	....	....	....
19	Notropis rubrifrons	o	o	o	....	o	o	....	..
20	Ericymba buccata	o	o	o	o	o	o	o	o
21	Rhinichthys atronasus	....	o	....	....	o	o	o	....
22	Hybopsis amblops	o	o	....	....	....	....	....	....
23	Hybopsis kentuckiensis	o	o	o	....	o	o	o	o
24	Cyprinus carpio	o	o	....	....	....	....	....	....
25	Ambloplites rupestris	....	o	o	....	....	....	....	o
26	Apomotis cyanellus	o	o	o	....	....	....	....	o
27	Mioropterus dolomieu	o	o	o	. ..	....	o	o	o
28	Percina caprodes	o	o	o	....	....	....	....	....
29	Hadropterus aspro.	o	o	....	....	o	o	....	o
30	Diplesion blennioides	o	o	o	o	o	o	o	o
31	Boleosoma nigrum	o	o	o	o	o	o	o	o
32	Etheostoma variatum	o	o	o	....	....	o	....	....
33	Etheostoma zonale	o	o	o	....	o	....	....	....
34	Etheostoma coeruleum	o	o	o	....	o	o	....	....
35	Etheostoma flabellare	o	o	o	o	o	o	o	o
36	Cottus ictalops	....	....	o	....	o	....	....	....

ADDITIONAL NOTES ON THE FISHES OF FRANKLIN, COUNTY OHIO.

By R. C. Osburn and E. B. Williamson.

In our paper on the Fishes of Franklin County, published in last year's proceedings of the Academy, (1898) we described as new, a species of *Etheostoma* under the name *sciotense.* Since that description was printed, Dr. Evermann, Ichthyologist to the U. S. Fish Commission, has compared the types of *Etheostoma sciotense* and *E. tippecanoe* Jordan and Evermann, and he writes that the two are identical, the squamation of the anterior dorsal region being the same in both, and the differences in coloration only such as may be explained by age, sex and season. *Etheostoma tippecanoe* has, so far, been recorded only from the Tippecanoe River, Indiana, and, while Dr. Evermann is doubtless correct in his decision, *tippecanoe* and *sciotense* show some interesting differences both in the arrangement and the color of markings.

Specimens of minnows, number 26, 27 and 28, *Notropis cayuga*, *N. blennius* and *N. sp?*, have been examined by Dr. Chas H. Gilbert, and our identification of *cayuga* and *blennius* confirmed. *Notropis sp?* is *Notropis shumardi,* (Gir). Our specimens agree very well with Girard's figure of this species in Girard's "Fishes"(Part IV, Explorations and Surveys for a Railroad route from the Mississippi River to the Pacific Ocean, Washington, 1858), Plate LVII, figs. 1-4.

During the spring of 1898 the enbankment confining the waters of Mirror Lake on the Ohio State University campus was broken by a freshet and

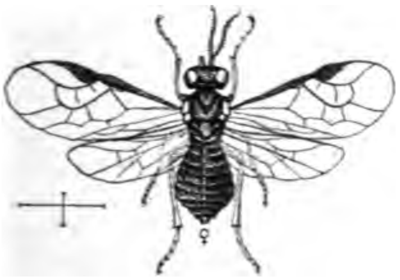
numbers of Carp, *Cyprinus carpio*, Goldfish, *Carrassius auratus*, and Tench, *Tinca tinca* escaped into the small stream which flows from the lake, and thence into the Olentangy River. In September, 1898, specimens of Tench were taken at the mouth of this small stream, so that the county list now stands at 70 species. Whether *Tinca tinca* will hold its own and multiply in the streams is a question. It belongs to the *Cyprinidæ*, the Minnow family, and superficially bears considerable resemblance to the Golden Bream, *Abramis crysoleucas*.

A FEMALE OF THE PURSLANE SAW-FLY, SCHIZOCERUS SP?, WITH A MALE ANTENNA.

By C. W. Mally.

During the summer of 1898, larvæ of this insect were observed to be mining very extensively in the leaves of purslane, and a quantity of infested leaves were placed in a breeding cage for the purpose of rearing the adults. As soon as these adults emerged, they were placed on a fresh plant in order that the method of oviposition might be observed. After watching them for some time, I noticed one female that appeared to have longer and more slender antennæ than the others, and both seemed to be placed on one side. The

specimen was at once captured and an examination revealed the fact that one antenna had apparently been broken off and the remaining one was like that of the male. The specimen seemed to be perfect in every other respect, and was observed to deposit a number of eggs after the usual manner. A large series of adults were then examined, but no other instance of this peculiarity could be found. The eggs had been deposited in the leaves with those of many other females, and, hence, no observation could be made as to the progeny of this individual. The illustration represents this specimen, showing the one antenna; whether the missing one was of the female type, or was also like that of the male, it is impossible to say, as the basal joint is alike in both sexes.



OBSERVATIONS OF THE OHIO FLORA.

By W. A. Kellerman.

(ABSTRACT.)

Bibliographical.—Many collectors have published lists of Ohio plants. The earliest of these date from a period soon after the first settlement of the State was

made at Marietta. The first list of great importance was contained in Riddell's Synoptical Flora of the Western States, followed the next year (1836) by a Supplementary Catalogue of Ohio Plants.

The first State Catalogue was published by J. S. Newberry in 1859; the second by H. C. Beardslee in 1874; and the third by Kellerman and Werner in 1893. Many important local and county lists have appeared from time to time.

The earliest specimens (collected by Menassah Cutler at Marietta) were accidently destroyed by fire. None of Riddell's specimens are known to be in existence except a small lot of about one hundred samples now in the library of Marietta College, and some in the New Orleans Academy of Science; the latter said to be in a poor state of preservation.

Newberry left no specimens to verify his list; in fact we are warranted in believing that his catalogue was largely a compilation and to some extent based on unreliable information. Dr. Beardslee made extensive collections and received material from many correspondents; a part at least of this material was subsequently placed in one of the Colleges of Northern Ohio, though no report has appeared concerning the same. The MS. from which his catalogue was published was his mere tentative list, his later and carefully prepared MS., having been lost in transmission to, or by, the parties who should have published it in Vol. IV of the Ohio Geological Survey.

The catalogue of Kellerman and Werner gave on the authority of the authors only those species that were authenticated by specimens; but it also listed all species reported, in each case citing the published authority. It is thus a record of all that had been published previous to that date. Now with perfected nomenclature and sequence of groups that accords with the present status of botanical knowledge—the anti-

quated having been by nearly all American botanists wholly discarded—and the recognized necessity of specimens to verify each epecies reported, our local and State lists can take a higher rank and be more reliable and useful.

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PLANTS NEW TO THE OHIO CATALOGUE.

By W. A. Kellerman.

During the year the following plants, new to the State, have been detached and representatives placed in the State Herbarium.

Ambrosia psilostachya, Columbus, Franklin County, F. J. Tyler.

Carex typhinoides, Perry, Lake County, F. J. Tyler.

Chenopodium leptophyllum, Sheffield, Lorain County, Miss M. E. Day.

Dentaria heterophylla, St. Marys, Auglaize, W. U. Young.

Helianthias form (near H. giganteus), Columbus, W. A. Kellerman.

Holosteum umbellatum, Cincinnati, Walter H. Aiken.

Hypericum drummondii, Cincinnati, Walter H. Aiken.

Veronica teucrium, Medina, Medina County, Miss Frances E. Thomas.

STUDIES OF USTILAGO REILIANA.

By W. A. and K. F. Kellerman.

An outline of investigations of the life-history of this Sorghum smut, with suggestions as to economic importance. Sorghum plants infected with the smuts by inoculation of the seed shown.

A BAT NEW TO OHIO.

By John F. Cunningham.

Nycticejus crepuscularis (Coues).

Nycticius humeralis (Rafinesque).

According to the last report upon the fauna of Ohio, all the bats reported for the state were members of the genera *Vespertilio* and *Atalapha*. Of the former geneus, *subulatus* (the little brown bat), *noctovagans*, (the silver black bat), and *fuscus*, (the caroline or dusky bat) were reported. Of the genus *Atalapha*, *noveboracensis*, (the red bat), and *cinereus*, (the hoary bat) were reported. This same work adds a note to the effect that "Nycticejus crepuscularis may occur in southern Ohio, as it is reported from Pennsylvania to Missouri and the south-west."

This latter clause, referring to the southern distribution of this bat seems to be true, for in "North American Fauna" No. 13, by Garret S. Miller, this bat, under Rafinesque's name *Nycticeius humeralis*, is reported from the following states: Arkansas, Florida, Georgia, Indian Territory, Kentucky, Louisiana, Mississippi, North Carolina, Pennsylvania, Tennessee, Texas, Virginia, and the District of Columbia. It would seem from this that it is of a more southern distribution, and it seems strange that specimens have not been reported from southern Ohio before this time.

But there is an old saying that "all things come to those who wait," and in some cases this seems true. The appearance of this interesting creature was a peculiar happening, and my being able to report it at this time is not at all my own fault.

While studying in my room one evening in May, 1897, I heard something thump upon the floor behind

me, and on turning about I was confronted by this little animal in a most defiant attitude. He had flown in at the open window. Not having time then to carefully study it I put him under a glass until morning when, upon investigation, I found that he was unlike anything in the Ohio report. So, I determined him to be a specimen of Nycticejus crepuscularis, or according to later reports, Nycticejus humeralis. The late Professor D. S. Kellicott confirmed my determination without the least reserve.

The family *Vespertilionidae* is now represented in this state, so far as we know by the three genera, *Vespertilio*, *Atalapha*, and *Nycticejus*. According to the classification set forth in Jordan's Manual of the Vertebrates of the United States, this family may be described as follows: "Insectivorous bats with the snout appendaged, or merely with two lateral excrescences. Wing membranes ample. Tail completly inclosed in the interfemoral membrane, or only the last joint exserted."

As to the division into genera, the first division is described in this manner: "cheeks without excrescences," and includes *Vespertilio*, (with incisors $\frac{2-2}{3-3}$), and *Atalapha*, (with incisors $\frac{1-1}{3-3}$).

The second division of the family is the genus *Corynorhinus*, which is characterized by having cheeks with two large excrescences, ears excessively large,—an inch high; teeth 36, incisors $\frac{2-2}{3-3}$.

The present genus *Nycticeius* was formerly included in the genus *Atalapha*. At present, however, it is a separate genus with these characteristics: teeth 30; molars $\frac{4-4}{5-5}$; upper incisors small, wings naked and interfemoral membranes nearly so.

Atalapha has thirty-two teeth, molars $\frac{5-5}{5-5}$, upper incisors stout, interfemoral membranes hairy above, and wings with furry patches. North American

Fauna, No. 13, changes the genus *Atalapha* to *Lasiurus*.

Nycticejus crepuscularis, Coues.

Nycticeius humeralis, Rafinesque.

Dental formula; i. $\frac{1-1}{3-3}$. c. $\frac{1-1}{1-1}$. pm. $\frac{1-1}{2-2}$. m. $\frac{3-3}{3-3} = 30$.

Length —3½ in. Extent 9 in. Tail 1⅛ in.

Ears small thick, leathery, and wide apart. Naked except at extreme base above; lower anterior half of inner side with a few scattered hairs. Membranes, like the ears are thick and leathery; attached at the base of the toes. A small wart above the eye. Fur somewhat scant, dark faun color above passing into brown below.

LIST OF PHAENOGAMS NEW TO OHIO OR RARE IN AND NEW TO COUNTIES OF NORTHERN OHIO.

By Edo Claassen.

1. Carex tnella, Schkuhr, Stark.
2. Carex tnuiflora, Wahl, Stark.
3. Cornus canadensis, L., Portage.
4. Drosera intermedia, D. C., Portage.
5. Myrica cerifera, L., Portage.
6. Potamogeton praelongus, Wulf., Stark.
7. Zannichellia palustris, L., Medina.

SECOND LIST OF THE LIVERWORTS (HEPATICAE) OF CUYAHOGA AND OTHER COUNTIES OF NORTHERN OHIO.

By Edo Claassen.

1. Blasia pusilla*, L., Cuyahoga.
2. Lepidozia setacea*, Mitt., Lake.

*Found sterile only.

THIRD LIST OF THE ERYSIPHEÆ, LEV. (WHITE MILDEWS) OF CUYAHOGA AND OTHER COUNTIES OF NORTHERN OHIO, TOGETHER WITH THE NAMES OF THEIR HOST-PLANTS.

By Edo Claassen.

1. Erysiphe cichoracearum, D. C., Asclepias syriaca, L. Cuyahoga; Aster novi-belgii. L., Portage; A. puniceus, L., Geauga; Carduus altissimus, L., Cuyahoga; Eupatorium, perfoliasum, L., Cuyahoga; Phlox paniculata, L., (Cult.) Lake; Vernonia gigantea, Walt., Portage.

2. Erysiphe communis, (Wallr.) Fr., Clematis virginiana, L., Cuyahoga; Venothera biennis, L., Lake; Polygonum aviculare, L., Cuyahoga Lake; P. erectum, L., Cuyahoga, Ottawa, Portage; Ranunculus abortivus, L., Cuyahoga; R. acris, L., Portage; R.

recurvatus, Poir., Cuyahoga ; Scutellaria lateriflora. L., Cuyahoga ; Thalictrum purpurascens, L., Lake.

3. Erysiphe galeopsidis, D. C., Chelone glabra, L., Cuyahoga.

4. Microsphaera alni, (D.C.), Webber, Castanea dentata, (Marsh), Sudw., Lake; Sambucus canadensis. L., Cuyahoga ; Syringa vulgaris, L., (cult.), Lake.

5. Microsphaera vaccinii, L. & P.. Vaccinium corymbosum, L., Portage ; V. vacillans, Kalm., Lake, Portage.

6. Podosphaera biuncinata, C. & P., Hamamelis virginiana, L., Cuyahoga, Summit.

7. Sphaerothera pannosa, (Wallr.), Lev., Rosa (cult.), Cuyahoga, Summit.

8. Uncinula clintonii, Peck, Tilia americana, L., Cuyahoga.

9. Uncinula macrospora, Peck, Ulmus fulva Walt., Cuyahoga.

10. Uncinula salicis, (D.C.), Winter, Populus monilifera, Ait ; Lake ; Salix cordata, Muhl., Geauga.

SECOND LIST OF THE UREDINEÆ OF CUYAHOGA AND OTHER COUNTIES OF NORTHERN OHI , TOGETHER WITH THE NAMES OF THEIR H ST-PLANTS.

By Edo Claassen.

1. Aecidium asterum, Schu., Aster paniculatus, Lam., Geauga ; Solidago caesia, L., Geauga ; S.

flexicaulis, L., Cuyahoga; S. serotina, Ait., Geauga.

2. Aecidium hydnoideum, B & C., Dirca palustris, L., Cuyahoga.

3. Coleosporium solidaginis, Thuem., Euthamia graminifolia, (L.), Nutt., Geauga; Solidago canadensis, L., Lake.

4. Gymnosporangium clavariforme, (Jacq.), Rees, Crataegus coccinea, L., Summit; Pyrus coronaria, L., Cuyahoga.

5. Melampsora populina, Lev., Populus monilifera, Ait., Lake.

6. Puccinia caricis, (Schum.), Rebent., Carex, Cuyahoga.

7. Puccinia nolitangeris, Corda, Impatiens biflora, Walt, Cuyahoga.

8. Puccinia rubigo-vera, (D.C.), Winter, Triticum vulgare, L., Erie.

9. Puccinia tanaceti; D.C., Vernonia gigantea, Walt., Cuyahoga.

10. Puccinia tiarellae, B. & C., Mitella diphylla, L., Cuyahoga.

11. Puccinia violae, D.C., Viola blanda, Willd., Summit; V. pubescens, Ait., Cuyahoga.

12. Uredo agrimoniae, D.C., Agrimonia parviflora, Ait, Lake; A. striata, Mx., Lake.

13. Uromyces hedysari-paniculati, (Schw.) Farlow, Meibomia canadensis, (L.), Kuntze, Cuyahoga; M. canescens, (L.), Kuntze, Geauga.

14. Uromyces Howei, Peck, Asclepias incarnata, L., Geauga.

15. Uromyces pyriformis, Cke, Acorus calamus, L., Cuyahoga.

FURTHER STUDIES IN PLANT EMBRYOLOGY.

BY LUMINA COTTON RIDDLE, M.SC.

Under this title was presented some preliminary work on the development of the macrosporangium of *Staphylea trifolia* L. Illustrations in india ink were shown of the stages so far studied. Owing to division of the hypodermal cells and numerous divisions of the tapetal cell, the embryo sac which developes from the lowest of the macrospores is very deep seated. This may possibly account for the fact that very few of the numerous ovules ever develop seed. Various stages of the embryo sac were shown, up to the mature form having egg apparatus, definitive nucleus and antipodals, perfect. A very pretty bipolar spindle was found in the first division of the macrospore mother cell.

SOME ABNORMAL PLANT SPECIMENS.

BY LUMINA COTTON RIDDLE, M.SC.

Frequently, while crossing the University Campus during October 1898, I noted the peculiar bushy heads of the common timothy *Phleum pratense* L. Nov. 6th, 1898, Professor Kellerman brought some in for class work, and, later, I made careful examination of these

peculiar heads. Two forms of abnormality were present.

1st. The flowering glume was greatly enlarged and resembled a diminutive leaf, having blade, sheath and ligule. Within the flowering glume were palet, stamens and pistil, but there was evidence that further development of the reproductive organs need not be expected.

2nd. The flowering glume and the palet were apparently normal but had been borne out from the outer empty glumes by a predicel about ⅛ of an inch long. This was not as common as the first mentioned and more conspicuous form.

The timothy was a second growth, having been mowed during the summer.

An abnormal specimen of *Onoclea sensibilis* L. collected by Professor Kellerman, showed gradations in leaf form between the normal sterile and fertile leaves. The spores found upon these intermediate leaves were apparently as perfect as those found in the fertile leaves.

Specimens of *Osmunda cinnamomea* L. bearing the fertile leaflets similarly to the closely related *C. claytoniana* L. were found in the State Herbarium. Other specimens had sori scattered over the backs of leaves which resembled the normal sterile leaf.

One specimen of *Botrychium virginianum* (L) Sw. shows division in the stalk of the fertile portion of the frond instead of the usual single stalk.

NOTES ON OHIO ASTACIDAE.

By E. B. Williamson.

In the basin of an old spring on the Ohio State University Campus during the last week of March, 1898, both *C. bartonii* and *C. diogenes* were taken. At the same time, a few feet distant in Mirror Lake, *C. rusticus* was found. Thus at one time, within a circle of five feet radius, the University ampus could boast of three species of crayfish. On March 28, females of *C. bartonii* had young, 10 mm in length, clinging to the abdominal appendages, while females of *C. rusticus* taken on the same date were carrying large masses of eggs.

In the University Museum is also a specimen of *C. diogenes* collected at Columbus on a paved street, during a spring rain in 1897.

The two following species have been added to the state list published in last year's Proceedings of the Academy, by Mr. R. C. Osburn and myself.

11. *Camborus blandingii acutus*, (Girard). Portage River, Oak Harbor, Ottowa Co. (Faxon).

12. *Camborus propinquus* Girard. Portage River, Oak Harbor, Ottowa Co. (Faxon).

Additional localities for species recorded for the state are as follows ;

Camparus bartonii, Warren Co. (Faxon) ; Licking Co. (R. C. Osburn) ; Tuscarawas Co. (H. L. Rietz) ; Knox Co. (Parker, Williamson, (sburn) ; Columbus (E. B. Williamson). This is the common brook species throughout the State.

Cambarus bartonii, robustus Big Jelloway and tributaries, Knox Co. (Parker, Williamson, Osburn).

Cambarus diogenes. Columbus (Ohio State University Zoological Museum) (E. B. Williamson); Montgomery Co. (S. E. Kasor); Knox Co. (Parker, Williamson, Osburn). This is the common burrowing, chimney-building cray in Ohio. *C. dubius* has been taken in Allegheny Co., Pa. *Dubius, diogenes,* and *argillicola* are the only species known to build chimneys to their burrows.

Cambarus propinquus sanbornii. Big Jelloway and tributaries, Knox Co. (Parker, Williamson, Osburn); Licking Co. (R. C. Osburn). This and *C. rusticus* seem to be the crays of the larger streams and rivers of the state.

Cambarus rusticus. Little Miami, Clark Co. (K. F. Kellerman, S. T. Orton); Licking Co. (R. C. Osburn); Grand Rapids, Wood Co.; Ottowa, Putnam Co.; McCutchenville, Wyandot Co.; and Tiffin, Seneca Co. (Faxon).

TWENTY-FIVE SPECIES OF SYRPHIDÆ NOT PREVIOUSLY REPORTED FOR OHIO.

By James S. Hine.

A paper which gives a list of species from a particular locality is of especial value to the student who is studying the distribution of species. It seems that in many monographs of groups of insects, specimens from Ohio have not been in the hands of the monographer, consequently our state fauna appears very limited. It is hoped that, before many

years, the volume on insects, promised years ago by those in charge of the Geological Survey of the state may be forthcoming, if not in the publications of that survey, in some form which shall be provided hereafter.

The family Syrphidæ is composed of a variety of species, some are shining while others are clothed with dense pile ; most of them are marked with yellow but some are uniformly black or blue. However variable they may be in other particulars they most all agree and are characterized, in having what is known as the spurious vein between three and five of the regular series.

With one or two exceptions, none of the species are known to be injurious, in the sense that the term is used in economic entomology, but on the other hand, many of them are beneficial as the larvæ in many cases feed upon plant lice, and in others act as scavengers in removing ordure and decomposing animal remains. Some species also live in the nests of ants and humble bees and in some cases at least are thought to be parasitic.

Many instances of protective resemblance may be cited in the family, thus in the single genus *Eristalis* we find species which closely resemble bees of the genera *Apis*, *Bombus* and *Osmia*, while other genera contain species which resemble *Vespa* and many other wasps. It would seem that we are safe in calling this resemblance protective since the species resembled is, so far as I am able to state, one that is well fitted for protecting itself. One is more strongly convinced if he observes some of the species on the wing. Thus, *Spilomyia longicornis* and others, resemble so closely our common *Vespa germanica*, that it takes the closest observation on the part of the collector to distinguish between them. Both species have the yellow, transverse bands on the abdomen, they fly in the same

situations, their actions are much alike and the sounds produced by the vibrations of their wings are similar. Anyone interested in mimicry and protective resembance would do well to make some observations on the members of this family.

As with many other groups, no attempt has been made in former years to catalogue our Syrphidæ, and, as far as I know, not a single species has ever been put down in literature as coming from Ohio, although many, from their published distribution would be considered as belonging to our fauna.

During the past few years, while collecting insects of various orders in different parts of the state, I have obtained a number of species. Mr. Dury, of Cincinnati, has collected a number, and other collectors have added one now and then, so that we have about one-eighth of the North American species represented in the University collection.

In the following list it is not my purpose to give all the species taken in the state, but only twenty-five of the best known and in many cases the most common. A report on the remaning species, and additions in the future, can be made at another time.

1. *Chrysotoxum laterale*, Loew. Taken at Medina, August 8, 1898. When taken, the specimens were flying in an open spot in the woods. When on the wing they appear much like the common *Vespa germanica*, being very near it in size. The noise of their wings first attracted my attention.

2. *Syrphus xanthostomus*, Williston. Taken at Medina and Akron, August 8—24, '98. The species seem to be quite common as numerous specimens were taken, all of them around flowers growing in sunny places, in woodlands.

3. *Syrphus ribesii*, Linn. Taken in all parts of the State, common on flowers of various kinds but

more especially on those of cultivated plants. Larvæ of Syrphus flies, most likely this species, are often seen devouring plant lice on different cultivated plants and trees. Most of the specimens in the collection were taken between July 1, and September 15.

4. *Syrphus americanus*, Wiedeman. Taken in various parts of the State, but apparently not as common as the preceeding.

5. *Didea fuscipes*, Loew. Taken at Sandusky, July 15, 1896, also at Columbus. Does not appear to be common.

6. *Sphegina lobata*, Loew. Taken at Medina, August 9, 1898. The single female taken was flying among foliage. in a sunny place near the edge of woods.

7. *Baccha aurinota*, (Harris) Walker. The species belonging to the genus *Baccha* are very long bodied. This is one of the largest and longest. A single specimen was procured at Columbus.

8. *Baccha fuscipennis*, Say. Taken at Medina, Aug 8, '98. Like the other species of the genus, this one has the habit of remaining almost motionless while poised in the air a few feet from the ground. The larvæ are known to feed on Aphides.

9. *Rhingia nasica*, Say. This species has the face produced into a snout-like projection nearly two millimeters in length. It is a common form and seems to be partial to the flowers of the wild touch-me-not, *Impatiens fulva*, as I have taken it repeatedly in them. Apparently a common species in all parts of the state.

10. *Sericomyia chrysotoxoides*, Macquart. This fine species has the transverse bands of the abdomen in the middle and slightly oblique. The costal margin of the wings is infuscated. In a certain place, in a woods at Medina, I always took species new to me every time I visited it. This is one of those taken

there July 22. 1898. for the first time in the state.

11. *Eristalis æneus*. Scopoli. This species is named from its color. It is the only Ohio species of the genus with the body naked and unicolorous. It is not a common species in the state, so far as I have observed.

12. *Eristalis albiceps*, Macquart. This species has only been taken in southern Ohio. It resembles *E. transversus*, but its abdominal markings are different.

13. *Eristalis bastardi*, Macquart. The thorax of this species is clothed with short, dense, yellowish pile, and the wings have a dark pecture near the middle. It appears to be common especially in the northern part of the state.

14. *Eristalis brousi*, Williston. This and number 13. I found flying together June 23, '98. along the edge of the water of Silver Lake near Akron. They would fly so rapidly that the eye could hardly follow them. and then come to rest suddenly on the sand, or on the stones which were lying on the beach.

15. *Eristalis dimidiatus*. Wiedeman. A common species throughout the State. I took it to Georgesville, March 20, '98, visiting the blossoms of our common willow. It is nearly naked and the abdomen is shining black marked yellowish.

16. *Eristalis transversus*. Wiedeman. The most common species of the genus. in the state. It is abundant in autum around the flowers of such composite plants as grow on the margins of swamps. While on the wing. it flies very rapidly and the noise from the vibration of its wings is plainly audible. The larvæ of this and many of the other species of the genus live in the mud and subsist on vegetable food. They are what are known as rat-tailed larvæ. so named because they are furnished with a tail or breathing organ at the caudal end of the body. This

they can extend or shorten at will and thus make it correspond with the depth of water above them. I have taken these larvæ repeatedly in the spring of the year.

17. *Eristalis flavipes*, Walker. This species has the appearance of one of our common humble-bees. It appears to be northern in its range. Specimens have been taken at Napoleon, July 7, 1896.

18. *Eristalis tenax*, Linn. Common in all parts of the State, and besides it may be expected in any part of the world. Williston gives its habitat as Europe, Asia, Africa, Japan and North America. Its larvæ live in decaying organic substances, and, therefore are valuable scavangers. The resemblance it has to a honey bee has made it a conspicuous species for centuries. Osten Sacken has associated this species with the oxen-born bees of the ancients.

19. *Mallota cimbiciformis*, Fallen. This species has been taken at Columbus in May, 1897, but does not appear to be common. It has a very close resemblance to *Eristalis flavipes* but may be easily separated from that species by the strongly thickened posterior femora. Some male specimens have a spine on the hind tibia above, while in others this spine is lacking. Both forms have been taken at Columbus. The latter form is noticeably smaller than the former.

20. *Tropidia quadrata*, Say. Common in September along the margins of ponds where water lilies and various other aquatic plants are growing. Here it flies from one leaf to another but resting a great part of the time. On September 8, 1898, I took numerous specimens of this species.

21. *Brachypalpus frontosus*, Loew. One male specimen taken at London, April 17, 1898. The uniform dark color, the thickened hind femora, and arched hind tibiæ of the male are characteristics of

the species. The whole body is clothed with rather long, light colored pile.

22. *Xylota chalybea*, Wiedeman. I took one specimen of this species, August 5, '98, at Medina. When I first saw it, it was resting on a log and I took it to be one of the ichneumon flies, but when it flew, my attention was attracted, as it then appeared like a dipterous insect. Its black wings and body together are characters seldom united in the same species in the diptera.

23. *Syritta pipiens*, Linn. A very common form, in August, along small streams in all parts of the State. It has some resemblance in coloration and actions to some of our hymenopterous insects commonly called sweat bees.

24. *Spilomyia longicornis*, Loew. Although distributed all over the State, does not appear to be common anywhere. I have taken it at Medina, Aug. 15, and at Portsmouth, Sep 9.

25. *Milesia ornata*, Say. This is one of the largest species of the family. Some specimens measure more than 22 millimeters in length. It has been taken at Newark (R. C. Osburn,)August 23, '98, and at Portsmouth, Sep 9, '97. At the latter place it appeared to be common and was found visiting the flowers of *Impatiens fulva*, in company with the preceeding species.

ADDITIONS TO A LIST OF BUTTERFLIES KNOWN TO HAVE BEEN TAKEN IN OHIO.*

By James S. Hine.

93. *Argynnis alceslis*, Edw. Numerous specimens taken in Medina county July 18. This was one of six species of the genus that I took in the same field, at about the same date.

94. *Anæa andria*, Scud. The Goat-weed Butterfly. A single male taken at Cincinnati, March 19. This is probably the farthest east the species has ever been taken.

95. *Thecla acadica*, Edw. A pair of this fine species was taken near Wauseon, July 8. The specimens when taken were resting on willow.

96. *Pamphila mystic*, Scud. Has been taken at Wooster.

97. *Pamphila viator*, Edw. This, one of the most beautiful of the genus, is apparently common about Akron. In the swampy ground adjoining Summit Lake I found the species flying in numbers among the high swamp grass. In their flight they appear like moths, and quite different from any other species of their genus with which I am acquainted. They were so numerous that by using the net once I took three specimens. The specimens were perfectly fresh July 26, the date on which I first took them.

98. *Ambluscirtes somoset*, Scud. I took several specimens of this species in open places, in woods, at London, June 5.

99. *Pholisora hayhurstii*, Edw. Taken by Mr. Dury at Cincinnati.

*Sixth Annual Report. Pages 22-27.

THE BLACK-CAPPED PETREL IN OHIO.

BY JOSUA LINDAHL.

Not less than three specimens of the rare Black-capped Petrel (Œstrelata hæsitata) were captured on the Ohio river last summer, 1898, after a violent gale on the Atlantic coast. This is the first record of any specimen of this pelagic bird being found in the State of Ohio.

A PLEA FOR SCIENCE IN THE PUBLIC SCHOOLS.

BY MARY E. LAW, M. D.

Is it not strange that in a country of free people, where individuality is at a premium, and where free speech, a free press, and a free ballot are guaranteed the humblest citizen, that we are so easily ruled by custom, tradition or the fashion of the hour.

Perhaps this subserviency to the established, the conventional, the conservative is most marked in the domain of education. Even the church, such a stronghold of conservatism and tradition as it is, bound by creeds and superstitions, shows the spirit of evolution and progress. There is a vital principle at work in the church which is evident to the most careless observer, and the scoffers outside the church

altogether, are obliged to admit that the millenium is nearer than it seemed ten years ago. Unity, progress, freedom of thought are the forces at the work in the churches and through them have come a more rational interpretation of the Bible and a more ethical and practical rendition of the Golden Rule.

But in the matter of popular education, "knowledge comes, but wisdom lingers.' It is interesting to consider the educational ideals which have ruled the world at different periods. In the early days of Grecian civilization, the training of youth was for physical beauty, eloquence and grace ; to be persuasive in speech and graceful in deportment were all that was expected of the aristocratic sons of Greece, for the slaves, who numbered more than a fifth of the population, received no education whatever. The life was so simple that mathematics were unknown. Pythagoras was the founder of mathematics which he introduced into the schools about 550 B. C.

We see, therefore, that there was a time when mathematics were unknown, and it was centuries before they became the core of our educational system as at the present time. May we not take a hint from this and eliminate a large part of the arithmetic and higher mathematics that we burden children with to-day. What practicle need have boys and girls for a mathematical course extending over ten or twelve years? It is simply a survival of the scholastic idea of education, that disciplinary studies need have no esoteric value. The new education discards all disciplinary studies that do not assist in the childs development.

As time went on, literature and language were added to the curriculum. For hundreds of years the schools taught Latin and Greek, but not the mother tongue of any student. No pupil was considered edu-

cated who used his native language, for instance, English, German, or French.

Education was aristocratic, and no educated person would use the language of the peasants and serfs. Is not there a little of that snobbishness still perceptible in our school and college curriculi? It is only within recent years that English has taken a prominent place in the course of study although it is destined to be the universal language.

Sometimes the priests had the monopoly of learning; they too formed a caste and education was confined to the monasteries,

After all these experiments in education, for nearly ten centuries ignorance like a dark pall fell upon the people, and every ray of light was excluded.

During the sixteenth century a new awakening occurred, and since that period there has been considerable progress in the matter of popular education.

John Amos Commenius is the first of the five or six great educational reformers of modern times. He was born in Moravia in 1592, and early in life he became a teacher. It is needless to describe the route by which he became world-noted, but suffice it to mention a few reforms in methods which he suggested and which underlie our present educational system.

First, he advocated the use of the vernacular instead of Latin and Greek. This was a great innovation. Second, that all children, rich and poor, the humble and the great receive instruction. This was the beginning of popular education. Third, that girls as well as boys be taught, which was one of the momentous events in the history of woman's enfranchisement. And last but not least, that children be taught the science of common things instead of literature and languages as was the custom.

Of course such radical reforms could not make much headway during his life-time, and even at this distant

period of more than three hundred years there is very little systematic teaching of the natural sciences in the public schools, hence this paper.

Rousseau the Frenchman, Pestalozzi the Swiss, and Froebel the German all accepted the general theories of Commenius and developed from them a pedagogical system based on natural science, instead of literature and language.

Perhaps no person of recent times has had a more powerful influence upon the development of scientific thought than Herbert Spencer, a man who refused a college education, as it did not in his opinion subserve the vital requisites of a successful business career, or prepare one for complete living. He has become through the development of his innate powers along the lines of least resistance one of the world's greatest philosophers and the most noted scientist of the present day. To read and assimilate the works of Herbert Spencer alone, would give one a liberal education. His essay on education published in 1860, while not as extensively read as many of his more profound works, is one of the most concise and convincing monographs on practical education that we have in any language.

While this paper is not intended as a restatement of Herbert Spencer's ideas, there is no doubt that the book which has been read many times and always with increasing interest, has had great influence in forming the writer's opinions upon what constitutes a practical education for the public school masses in an industrial republic like ours.

We have seen how rhetoric, literature, languages and mathematics have ruled the schools at different periods, and to-day, a plea is made for a scientific education.

We will first consider it from the stand-point of utility, for the perservation of life depends upon our knowledge of the physical sciences. Is there any

question as to the necessity for teaching children the care and functions of the different organs of the body, so that they may know how to preserve their existence, and their power to do and enjoy, or shall they spend their time instead upon literature and arithmetic? What availeth a man if he gain the whole world and lose his own soul?

Shall he learn the chemistry of food and how to augment his strength and power or shall he spend precious hours learning myths and fables?

In how many ways is he indebted to the science of physics, not only for his bodily health but for his success and happiness in whatever pursuit he enters upon in after life. The origin of the seasons, the phenomena of light, the pressure of the atmosphere, the buoyancy of water, the velocity of the wind, the expansive power of steam and crystallization, the effect of heat and cold, the force of gravity, the mechanical principles that underlie the application of power to practical purposes, and a thousand and one things that the child is experimenting with every day, should be explained to him in a truly scientific manner.

The time to teach children these subjects is when they first attract their notice and possess sufficient novelty to secure involuntary attention.

They should be taught the principles which govern the barometer, thermometer, compass and clock, and all the mechanical contrivances they come in contact with in their daily life. Think of the thousands of so-called educated people, who consult a thermometer a dozen times a day without the slightest knowledge of its philosophy. People have become so accustomed to going through the world with their minds dulled by ignorance that they no longer have interest in their surroundings. Children at first show great curiosity about the new world they have entered, but after asking in vain for explanations from their parents and teachers,

they cease to inquire and the windows of the soul become blurred and they go groping about in this world of beautiful mysteries like an owl in the day-time.

Nature study, which is a development from the kindergarten, is a step in the right direction, but is not scientific enough. While it is a great thing for children to gain a love for the beauties of nature, it is quite as important that they understand the laws which govern their every manifestation. Their lives depend upon the knowledge of natural law and physics or the science of natural phenomena should be the basis of all the science teaching.

More than thirty years ago an intelligent father, a director of a country school engaged a teacher who had studied natural philosophy, as it was then called, so that his children, a boy and girl of eight and ten might be taught the laws which governed the natural phenomena about them. The children were filled with enthusiasm for the new study, and in a few months had acquired such a knowledge of natural law as to influence their whole lives. The great forces of the universe were illustrated through toys and simple apparatus, and the logical habits of thought thus formed were a life-long possession.

They were considered the best students in a large family although the other members were educated in the graded schools of the city.

We read a few days since of a large gas tank collapsing in New York City, while being tested by water pressure, and the destruction of many lives in consequence. Probably no one engaged in the work except the engineer knew of the tremendous pressure exerted by 8,000.000 gallons of water a; that height.

All the phenomena of steam, ice and air can be illustrated in the public schools with the simplest apparatus and to the delight of the children.

Physics can be made a most fascinating study

and should be taught scientifically in every grade of the public school.

The elements of Astronomy can be made intilligible to every child and what study is more elevating. Elementary Chemistry should have a place in every curriculum of the elementary schools, and Botany and Natural History goes without saying.

The formation of the air we breathe, the water we drink, the food we eat, the soil we cultivate should be known to every child by the time he is twelve years old.

Frederick Friebel has proven himself to be the greatest scientific pedagogist the world has yet seen, as his system of infant education embraces the elements of every Art and Science. All the public school needs to do is to complete the work begun in the kindergarten.

One of the most important lessons for young people to learn, is that the world is governed by law and that luck means opportunity, not chance.

A short time since a young man was discussing this subject of luck and said that it was the leading factor in all great enterprises and gave as an illustration this occurrence. A business man had a bad debt and in order to secure himself he took 30 acres of unimproved land in another state. When he came to examine it he found to his dismay that it was a sort of swale under water most of the year. In a few years the country put through it a ditch and his taxes for the same were equal in amount to the original debt. A year or two later a forest fire swept over the land destroying every vestige of vegetation. He tried in vain to get rid of his bad bargain but to no avail. When he visited it again a year or two later what was his amazement to find a field of basket willow growing luxuriantly which has proven to be a veritable mine of wealth. All luck, says the young

man. No, says the philosopher, had he understood the chemistry of soil he might have produced the same effects years before. Nothing occurs contrary to law. Know the law, and the law shall make you free.

Is it not of the greatest importance that science should form the basis of our public school instruction. I will say then that education should be first of all for utility and it will grow beauty, ethics and religion as naturally as a rose developes by obeying the law of its own being.

We are as a race entitled to happiness, and as happiness is conditioned by our environment, let us become acquainted with the forces that surround us, that we may use them to our benefit and not to our destruction. Art, music, poetry and architecture are all based on scientific facts, and a knowledge of the natural sciences is essential to success in any line of endeavor.

From an ethical standpoint there is no system of education that will develop higher qualities of mind and soul than the pursuit of science. What better examples do we need of ethical character than Agassiz, Humboldt, Darwin, Tyndall, Herbert Spencer and hundreds of others. Science is an exacting mistress, and the frivolities and vices of every day life hide themselves from her august presence.

If we desire to give boys and girls an absorbing life-long interest, let us give them thorough scientific training in the elementary schools.

No great mind becomes irreligious through the pursuit of science. It may discard the superstitions and unscientific explanations which cluster around the religious books, but every man who recognizes law in the universe admits that there is still the source of the law unknown, and as Herbert Spencer believes unknowable. If we wish children to be really religious, let us first make them scientific.

My plea then is for exact science in all the public schools. Let our boys and girls have a thorough education in science, even if they have to dispense with Latin and Greek and ancient history. Science rather than Latin is the basis of the professions and any young man and woman who understands the natural sciences will make a success of his vocation, no matter what it may chance to be. Commerce, manufactures, agriculture, trades and labor of all kinds would be advanced in value a thousand fold, if men understood the laws which govern them.

THE DEVELOPMENT OF THE MICROSPORANGIA OF HEMEROCALLIS FLUVA.

By Edward L. Fullmer.

Note: This paper was illustrated by a number of original drawings.

A cross section of a very young stamen at the point where the microsporangia are to be formed, shows only a rectangular area, which consists of epidermal and general tissue cells. By the rapid growth of the microsporangia this area soon becomes somewhat heart shaped. Three or four hypodermal cells of each sporangium become differentiated as the archesporial cells. The cells of the archesporium divide by periclinal divisions, giving rise to the primary sporogenous cells and the primary tapetal layer. The cells of the

primary sporogenous tissue multiply rapidly, forming, however, only sporogenous cells is practically complete when the primary tapetal layer begins to divide. In cross section the sporogenous cells. The division of these cells are about four times as numerous as the primary sporogenous cells. They form a somewhat cylindrical mass of tissue which becomes separated from the tapetum. While the sporogenous cells are enlarging and differentiating the division of the primary tapetal layer takes place, the cells of which by dividing by periclinal divisions form a wall layer and an inner layer. The inner layer divides into two, forming an intermediate or middle layer and the layer which developes into the peripheral part of the tapetum. The axial part of the tapetum in Hemerocallis is derived from the adjacent general tissue in all cases.

About the time the cells of the sporogenous tissue are in the spore mother cell stage, the middle wall layer breaks down and disintegrates. The wall of the mature anther consists of the thick walled endothecial cells, having thickened reticulate bands, and of the disintegrated epidermis.

ADDITIONS TO THE LIST OF OHIO DRAGONFLIES.

BY JAMES S. HINE.

Previously, ninety-seven species of Ohio dragonflies have been reported, and published in the proceedings of this association. The past Summer's collecting has

added some species, and notes on others which, to complete the list to date, should be published in the coming Annual Report of the Academy.

98. *Enallagma traviatum*, Selys. On the eleventh of June, of the present year, Mr. Dury, of Cincinnati, sent in for determination a pair of this species. A little later, several specimens of the same species were taken among the numerous lakes in the vicinity of Akron. It might be worth mentioning that thirteen species of this genus are now known from the State. Less than twenty species of the genus have been described from America north of Mexico.

99. *Libellula exuta*, Say. This was taken June 23, at Stewart's Lake, in Portage County. Four specimens, all males, were taken in a few minutes and on a very unfavorable day, so it must be that the species was common in that vicinity.

This makes the ninth species of this genus, as we have arranged them, from the state.

In this connection it might be well to mention that Mr. Dury is certain he saw *Anax longipes*, Hagen, at Cincinnati, but did not procure it. The species is a conspicuous one and its brick red abdomen and large size ought to serve to identify it, even on the wing. Counting this species, the list contains 100, the number we expected to find, eventually, when the work was begun.

The following rare or local species have been retaken the past summer:

Erythromma conditum, Hagen. Sugar Grove, April 21. Several specimens, male and female.

Enallagma divagans, Selys. Three males taken at Stewart's Lake, June 21.

Enellagma hageni, Walsh. Numerous male and female specimens taken at Stewart's Lake, June 21.

Gomphus lividus, Selys. Two males taken at Sugar Grove, April 21.

Gomphus furcifer, Hagen. One male taken at Stewart's Lake, June 21.

Tramea onusta, Hagen. Male specimens taken at Cincinnati, May 23, by Chas. Dury.

Libellula cyanea, Fab. Several males taken by J. B. Parker at Danville, June 22.

Libellula quadrimaculata, Linn. One male taken at Danville, June 22, by J. B. Parker.

Ceithemis fasciata, Kirby. Several males and a female taken at Silver Lake, Akron, June 23.

SOME OBSERVATIONS ON THE TOPOGRAPHY OF ATHENS AND VICINITY.

BY C. H. STEARNS.

South-eastern Ohio presents some very complicated problems to the topographical geologist. Among these complications, those of Athens county are notable and of peculiar interest; for through this section flows the Hocking (Hockhocking) river, along a valley now many times the width of the stream, and through glacial drift gravels of immense thickness, and along the hill-tops, close to Athens township, are evidences of an ancient, pre-glacial river which flowed in quite a different direction than that of the present Hocking, viz., to the south-west, on, we believe, to the Ohio, by way of the Sciota River.

Let us first consider, briefly, the course of the Hocking river, especial from Salina, six miles above Athens, to a point somewhat below the town.

The river from Salina pursues a very sinuous course, running due east, then south-east, south and south-west; then south-east again, on around Athens, continuing in a generally south-easterly direction to the Ohio river. At Salina we note the end of a ridge which constitutes a divide between the present and an old river valley. The latter, forms what is now known as the "Plains," and is frequently referred to as a "terrace." This old river course was filled with glacial drift, which subsequently has been covered with aluvium. Some very large mounds and other earthworks are found upon it. These valleys join some two and one-half miles to the southeast. This divide has been subjected to great erosion. The ridges bordering the Plains are studded with some notably high peaks.

For the greater part of the remaining distance to Athens, the course of the present river follows the valley, hugging the base of the southern hills. The glacial drift gravels are plainly outlined through the greater part of the valley. Tributary valleys along the whole course are numerous.

The great deepening effect of the glacial waters was largely obliterated by the immense burden of gravel which came down from the edge of the ice at the time of its maximum advance, this drift being deposited in the valleys hundreds of feet in depth, which subsequently were cut into terraces by the "flood waters" from the retreating ice. Just above the town of Athens, a gravel deposit of two hundred feet above the present river level was noted, and a boring in the old river bed, in the eastern part of the town, showed gravel at a depth of sixty feet below the surface of the present river.

Standing on North Hill, three hundred feet above the river, we note the fact that certain tributary valleys enter the Hocking valley against the current, one indication that the old pre-glacial stream flowed in another direction, and, following along the top of the ridge

toward the west, we can see a very perceptable break in their outline. The natural inference is, therefore, that through this cut ran the stream in question. To establish the truth or falsity of this theory has been the object of several trips over these hills, and on to a point within four miles of Albany. Here we are met with the complications, already referred to, each of the many high ridges and their enclosed valleys, offering a tempting study in themselves. But the main point to be kept in mind is the drainage of the old peneplain. We have succeeded in defining the general boundaries of the commencement of this great south-west river valley, as we suppose. Lack of time has precluded the possibility of tracing the course beyond Lee township, but from what we have gathered by inquiry concerning the topography below that section, there is reason to suppose that the outlet can be traced still farther.

Of the tributary valleys before referred to as flowing in a direction opposite to the Hocking, we have made a partial study of the one just across from Athens, viz., Rock Riffle. While passing up the valley, it is interesting to observe that petrified wood has been found in the bed of the diminutive stream. And, indeed, to the southeast of Athens, along the Jerseyville road, such petrifactions have been found in considerable quantity, including some large fragments of tree-trunks. Coming to the head of the valley, we meet, perhaps, as complicated a configuration as is to be found in this locality. We find the hills of exceptionally high altitude, and much cut up by erosion. A broad ridge separates Rock Riffle valley from one to the east, also communicating with the Hocking valley, and from the southeast another valley joins it.

Taking now, a course mainly to the west from the head of Rock Riffle, we pass along the northern boundary of another valley, which is soon joined by a second valley from the southeast: and on coming to

the Albany road, we note a confluence of this with two other valleys. The valley thus formed continues but a very short distance, when we reach the Hocking valley.

The Hocking River even now seeks a new course over its flood plain. Such is noted in the Athens Loop. On the southeast of the town proper, the river not long ago, changed its course from a horse shoe-shaped situation to a nearly straight bed. Again, directly south, we find the same occurance. At this place, as the river changed its bed, it flowed clear around the neck of land and made an island. Some of the oldest citizens remember where the people living on this island were obliged to visit town in a boat. At both places the old river bed is plainly visible.

There is another such horse shoe bend at the base of the Asylum hill, but though the river here struggles for a new course, the State keeps it back by large dykes.

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Ohio State Academy of Science.

SPECIAL PAPERS NO. 1.

SANDUSKY FLORA.

A CATALOGUE
OF THE
FLOWERING PLANTS and FERNS

GROWING WITHOUT CULTIVATION, IN ERIE COUNTY, OHIO,
AND THE PENINSULA AND ISLANDS
OF OTTAWA COUNTY,

By E. L. MOSELEY, A. M.

PUBLISHED BY THE ACADEMY OF SCIENCE,
MAY, 1899.

PRESS OF CLAPPER PRINTING CO.
WOOSTER, OHIO.

TO THE MEMORY

OF THE

MEMBER OF THE ACADEMY

WHOSE DEATH IS ANNOUNCED,

AS THE PROOF OF THE LAST PAGES OF THIS "SPECIAL PAPER"

ARE BEING RETURNED TO THE PRINTER,

MANNING F. FORCE.

GENERAL, JURIST, SCIENTIST, AND ABOVE ALL, A MAN WHOM

NO DESIRE FOR WEALTH OR FAME COULD DIVERT

FROM THE FAITHFUL SERVICE OF HIS

FELLOW MEN, THIS WORK IS

DEDICATED.

SANDUSKY FLORA.

The flora of the Sandusky district is a rich one. We believe there is no other local collection of Ohio plants that approaches within three hundred species of the number collected in the past seven years, in Erie county and the eastern part of Ottawa county, and now preserved at the Sandusky High School. Of the many local lists published in other states, we have seen none that give so many native species as have been found near Sandusky, although several of them cover much larger areas and represent the labors of many botanists working for long periods of time. Some of these lists, moreover, include territory that is regarded especially rich in plants.

The "Flora of Buffalo and its Vicinity," by David F. Day, presents the names of all the plants which have been detected within fifty miles of Buffalo, a territory many times as large as Erie county, Ohio, and including on the one side the whole of the Niagara river with its profusion of flowers and ferns, and, on the other mountains with an altitude of 2300 feet above the sea. "The Cayuga Flora" by William R. Dudley, published as a Bulletin of the Cornell University, covers an area 65 miles in extreme length and is based on numerous collections, the first of which was made in 1827. The "Plants of Monroe county, New York, and Adjacent Territory," published by the Rochester

Academy of Science, in addition to Monroe county, which is about three times as large as Erie county, Ohio, includes portions of five other counties and gives twenty species reported by early botanists, but no longer found. All of these districts border on Lake Ontario and one of them on Lake Erie also.

The whole of England contains but about 1200 native phenogams; surpassing the little district about Sandusky by less than a hundred species.

Although several hundred native plants not found in Erie county grow in one place or another in Ohio, yet so well is the flora of the state represented here, that it is probably not too much to say that excepting the counties bordering on the Ohio river and those that contain sphagnous swamps or bogs, there are few counties in the state where a botanist, unfamiliar with the territory would be likely to find in a single day's search more than halt a dozen native species that do not grow somewhere in Erie county. The surpassing richness of the Sandusky flora is not due to the fact that it includes islands within its territory, for scarcely any of its species are confined to the islands, nor is it in very large measure due to the fact that it includes species that are confined to the lake shore but rather to peculiarities of climate and geological features, both of which depend to some extent on the proximity of the lake.

CLIMATIC INFLUENCE OF LAKE ERIE ON VEGETATION.

The Catalogue of Canadian Plants in six volumes includes the whole territory lying north of the Great Lakes and extending from the Atlantic to the Pacific. The Sandusky district contains 165 native species and varieties not given in the Canadian catalogue besides a

number of others which in Canada are confined to Pt. Pelee or Pt. Pelee Island, spots only a few miles distant from the islands of Ottawa and Erie counties, Ohio. The Sandusky district contains 67 native plants not known to grow anywhere in Michigan and many others which in Michigan are confined to the south-western part where the climate is tempered by Lake Michigan. But what seems quite as remarkable is the fact that the Sandusky district contains 305 native plants not known to grow within fifty miles of Buffalo, while the Buffalo district has about 244 native species and varieties not given in the Sandusky list. But even this great difference between two regions bordering on Lake Erie is largely due to climate, for the summer at Buffalo is not only cooler but lasts less than three-fourths as long as at Sandusky. Since the prevailing winds have traversed Lake Erie for nearly its whole length before reaching Buffalo the mean temperature in summer there is about 3° lower than at Sandusky. In the spring the difference is even greater than in summer, being about 5¼° lower in April and May. This is due to the fact that when the ice breaks up it is blown to the east end of the lake and remains so crowded there as to prevent navigation three weeks or more after Sandusky Bay has been clear. The average date of the last killing frost in spring in Sandusky, is April 14; at Buffalo, May 20, that is 36 days later. Moreover, Sandusky is protected by its position from cold north-west winds in autumn, while Buffalo is not, so that the first killing frost at Sandusky does not come on an average until October 23, but at Buffalo October 5, that is 18 days earlier.

Like an east and west mountain range, Lake Erie protects the plants on its south side from cold north winds while they get the full force of winds from the south, but with the vegetation on the north side it is the reverse. Moreover, the heat given out by the

water in winter as it freezes, modifies the climate of the adjacent land. It would seem that an equal amount of heat should be absorbed by the ice in melting, and thus the winter prolonged into spring, but for the region about the western end of the lake this is not true, because a great part of the ice is blown away toward the east end of the lake, whose period of cold is prolonged thereby. And so it comes that the climate on the south side of Lake Erie is not only milder than that on the north side but much milder than that at the east end, and, if we reckon the length of summer from the average date of the last killing frost in spring to the average date of the first killing frost in autumn, we find the summer at Sandusky to last 192 days and at Buffalo only 138 days.

The counties of Ohio lying to the east of Erie county and bordering on the lake have a climate somewhat less mild than that of the Sandusky region for their land rises more abruptly from the water, and the prevailing winds pass over more of the lake before reaching them. In Erie county the land within a few miles of the lake is mostly much less than a hundred feet in elevation. The temperature at Sandusky in spring and summer averages about one and a half degrees higher than at Cleveland, and one degree higher than in the eastern part of Erie county, four miles back from the lake shore where Mr. W. H. Todd has recorded observations for the government for many years.

It is interesting to observe that the protection from frost afforded by Lake Erie scarcely extends beyond the counties that border upon it and, as a result we have many plants in these that have not been reported from any other county north of the middle of the state, and quite a number that have been found nowhere else in Ohio except in the southern part, within forty miles of the Ohio River. Even so far south as Columbus, the

last killing frost in spring occurs on an average six days later than at Sandusky and the first killing frost in autumn five days earlier.

CLIMATE OF THREE CITIES

ON LAKE ERIE AND ONE A HUNDRED MILES SOUTH OF IT FROM TIME OF ESTABLISHMENT OF WEATHER BUREAU IN EACH PLACE TO END OF 1897.

		Sandusky.	Cleveland.	Buffalo.	Columbus.
Weather Bureau Established.		1878.	1869.	1870.	1878.
Mean Temperature.	January	26.2	26	25	28.4
	February	29.4	26	25.3	32.1
	March	34.7	33	30.5	38.1
	April	47.7	46	42.5	51.2
	May	59.5	58	54.2	62.0
	June	68.8	68	65.4	71.3
	July	73.6	72	70.2	74.9
	August	71.6	70	69.1	72.3
	September	65.6	64	62.5	66.1
	October	53.7	52	51.2	53.7
	November	41.2	40	38.4	41.2
	December	32.8	31	30.5	33.3
	Annual	50.4	48.8	47.1	52.1
Lowest Minimum.		−16	−17	−14	−20.3
Highest Maximum		100	99	95	103
Av. date last killing frost in spring		April 14.	May 1.	May 20.	April 20.
Av. date 1st killing frost in fall.		Oct. 23.	Oct. 11.	Oct. 5.	Oct. 18.
Av. rainfall in inches		34.69	34.82	39.66	38.74
Av. relative humidity		72.07	72.0	74.5	71.4

GEOLOGY.

The physical feature of Erie county which causes most difference between its flora and that of the counties to the east is the existence of prairies in its southern and western part. These prairies are of two

sorts, each having its characteristic plants, while many species not known to grow farther east in the state are found on both of them.

Extending over the greater part of the township of Oxford, and over portions of the townships of Milan, Huron, Perkins, Margaretta and Groton is a nearly level prairie which probably at one time formed the bottom of the glacial lake that preceded Lake Erie and later of a bay or bays partly shut off from the lake by sand bars which still exist. Underlying most of this prairie is the Ohio shale, which in many places is close to the surface. The ground requires tiling to produce good crops. The other prairie lies north and west of the village of Castalia, extending to the western boundary of the county. The soil of this is different from the other, being a calcareous deposit from the water of the Castalia springs. Within the memory of men still living a great deal of this prairie was under water much of the time. A considerable portion of the region extending south of Castalia for a distance of over fifty miles has no surface streams, but the water descends through the joints of the limestone and flows through subterranean passages which it has made in the soluble rock of the Waterlime formation. This water charged with lime carbonate issues from the ground in numerous bold springs in the vicinity of Castalia, which owes its name to this circumstance. These springs are the largest and most beautiful in Ohio. The slope from Castalia to Sandusky Bay is very gradual and before any artificial drainage was established, the region was a marsh filled more or less with the calcareous water whose deposits have formed over thousands of acres to a depth of many feet. In some places these deposits are indurated forming a tufa, in others, soft making a shell marl containing the remains of millions of Limnea and Planorbis of the same species as live in the bay now. The tufa is composed mostly of petrified Chara

and other plants. The shape and venation of leaves is well preserved, one of the most common kinds being that of *Hypericum* kalmianum which grows over much of the surface. On this prairie as well as on the Oxford prairie grow many plants not found east of the Huron river either in Erie county or the counties beyond.

Sandusky and Margaretta as well as Marblehead Peninsula and Kelley's Island are underlaid by Corniferous limestone which comes near the surface over much of this region. In many places, especially on Marblehead, the covering of soil is only a few inches or a fraction of an inch deep and consists of partially decomposed vegetation and lime carbonate derived from the underlying rock. Quite a number of species are characteristic of this calcareous soil. Catawba Island, as it is called, and the islands of the Put-in-Bay group have a similar character but the rock is older, belonging to the Waterlime formation. Over the greater part of Sandusky and in many places on the islands, the limestone is covered with clay of variable thickness, but in many parts the soil is too thin for trees to attain a large size, for even if they could obtain nourishment enough, they are likely to be uprooted by a strong wind. The glacier that passed over this region left traces that still show in hundreds of places, including some grooves on Kelley's Island and Marblehead which so far as we know are unsurpassed elsewhere in the world. It is interesting to observe that the grooves on the different Islands, on the Peninsula and in Sandusky and Margaretta have the same direction, running about twelve degrees south of west, or parallel with the axis of Lake Erie, excepting a few which have quite a different direction and indicate a movement of the ice at a different time. Where the superimposed drift has protected the rock from weathering, it not only retains the deep grooves but shows everywhere a highly polished surface marked with fine parallel lines.

In many places in Sandusky this polished limestone requires no quarrying to serve admirably for basement floors. So level is the rock and the overlying drift that for miles around the city, the eye can scarcely detect any elevatioas or any depressions with the exception of slight ones made by small streams.

Many of the rare plants of Erie County grow in sand, especially in the sand deposits east of the village of Milan and along the sand ridges that stretch east and west in Margaretta township and along the border of the prairie in the southern part of Perkins township. These were formerly lake beaches and just below the sand ridge that extends south-west from Castalia is a ledge of limestone which shows very plainly the action of the waves, though it is now four miles from the water. When the lake had settled to a lower level, it must have beat against the foot of this ledge, undermining the rock and causing it to break away in large masses, as it is doing now at the west end of Rattlesnake Island and elsewhere. These detached masses often settled but a few feet, leaving deep but narrow chasms between them and the parent cliff, and these chasms are but partially filled even to the present day with dirt washed in from above. In places, trees grow out of them and the walls are bedecked with ferns. The rich woods covering the side of this hill, which I have called Margaretta Ridge, the sandy fields at the top and the prairie below afford a variety of plants found nowhere else in the county and a large number of species unknown in the counties farther east.

The Huron River divides Erie county into an eastern and western part. Few of the plants which grow in Erie county and not in Lorain or Cuyahoga counties are found east of this river. West of it are no natural surface streams that continue to flow all summer and except near the river no ravines. The

valley of the Huron and its tributaries therefore afford some species not found nearer Sandusky, but as it is cut through shale, it is not so rich as the valleys farther east. At Berlin Heights, the Old Woman Creek has cut a picturesque ravine through the Waverly sandstone and into the Ohio shale. Here grow several interesting plants not found farther west. But still deeper ravines have been formed in Florence township by the Vermillion River and its tributaries, the walls mainly of shale, but in the southern part of the township also of sandstone. Here have been found many species of sedges and other plants that do not seem to grow along the Huron or west of it, though most of them grow in the counties to the east where there are still deeper ravines in the sandstone. The walls of these ravines like the walls of a cellar are warmed slowly in summer, so that on the north side of steep, wooded slopes, are some cooler spots than any near Sandusky and hence many plants which are more common farther to the north and east.

The lake shores and marshes furnish quite a number of species not found in the interior of the state. Cedar Point consists of low sand ridges thrown up by the lake and separating it from Sandusky bay and its marshes for a distance of seven miles. Throughout most of its length the plants are comprised in few species but toward the end it is wider and probably older, having a richer soil and more varied flora. Although more accessible from Sandusky than any other good collecting ground and appearing not to have a great number of species, yet so many rare forms grow there in one place or another that it is not improbable that some plant not on our list at all may yet be found there. Seven years ago, before the work of making a herbarium had been commenced, the writer thought he had found on Cedar Point about all the species that grew there, but each year he has added

something from that region, which he had never found before either there or elsewhere. In the number of rare species, Cedar Point is surpassed by Marblehead, though the latter has a larger area. Altogether the Sandusky district has furnished more than a hundred species and varieties that were not known to be growing wild any where in the state, previous to their discovery here.

FLORA OF THE ISLANDS AND ITS ORIGIN.

With the exception of some of the little ones, the islands of Ottawa county, and Kelley's—the only island belonging to Erie county,—have been visited many times and at different seasons. Of the plants growing on six of the islands in the lake, separate lists have been kept and an attempt made to make them complete. These lists are not published except as a part of the general list of plants comprised in the Sandusky flora, but a fair idea of the results may be obtained from this by bearing in mind that all the plants marked common or abundant have been found on one and, in nearly all cases, on more than one of the islands, except a few which are noted otherwise. The names of plants not common on the mainland but occuring on Kelley's Island and two or more of the Put-in-Bay group are followed by the word—Islands. If found on Kelley's island and only one other, or not on Kelley's the names of the islands on which the plant has been found are given. The number recorded for each island is as follows:

Kelley's Island	461.
Put-in-Bay	439.
Middle Bass	306.
North Bass	282.
Rattlesnake	192.
Green Island	115.

It will be seen that the numbers correspond pretty well with the size of the islands, the largest island having the greatest number of species, the next in size the next greatest number, etc. The different islands are very similar in character, consisting of limestone covered more or less with clay and without any permanent streams. The difference in physical features and the difference in flora between the islands are much less than between parts of the mainland of Erie county separated by shorter distances. The entire number of different species is 612. Fourteen of these are Naiadaceae growing in the water of bays or along the shore, most of them at Put-in-Bay and North Bass. The islands are poor in ferns, the whole number of species being only eight, of which Kelley's has six, Put-in-Bay three, all scarce, Green Island two, Middle Bass and Rattlesnake one each, and North Bass none. We have found on them no orchids and no Ericaceae. Kelley's island, owing to its extensive commerce and cultivation, together with the protection from frost afforded by the water, has many naturalized species, especially along the south shore, two or three of which have not been noticed elsewhere. Excepting these and three rare sedges, and one rare golden rod, the islands appear to have no plants that have not been found also on the mainland of Erie county or on Marblehead, —not so many species as are afforded by each township of Erie county, excepting Groton. However, in view of the fact that the islands have no permanent streams, no ravines, no alluvial soil and little or no sand except the barren sand in some places along the shores, their flora is probably as varied as that of equal areas on the mainland where these defects exist. Their combined area is only about ten square miles.

It has been supposed that the lake, which after the melting of the southern portion of the glacier overspread a larger area than Lake Erie does now, sub-

sided until what are now the islands appeared above its surface. This view is doubtless correct, but there is now much evidence to show that it continued to subside until the islands formed part of the mainland and afterward rose and isolated them again, and is still rising and likely to submerge them again. The old beaches which may be traced for long distances running nearly parallel to the present shores of the Great Lakes, must have been level at the time they were formed, but they are not now level, and there has therefore been a tilting of that part of the earths crust which includes the basins of the Great Lakes, as there has been of many other parts. These beaches all have gentle slopes, toward the south and south-west, indicating that in this part of North America, there has been an uplifting of the land toward the north north-east or a depression toward the south south-west or both. The effect of this tilting of the basins of these lakes has been to raise the water on the south and west as compared with that on the opposite sides, just as the tipping of a saucer partly filled with water would do. The fluctuation of the water due to variable winds and rainfall make such comparisons difficult, but Mr. G. K. Gilbert found by comparing the heights above the normal level of Lake Erie in 1895, of a certain point in Cleveland, and a certain point at the head of the Welland canal with the heights of the same two points as carefully determined in 1858, that the point near the north-east end of the lake rose 0.239 foot as compared with the point in Cleveland. This is a small amount and in view of the difficulty of determining the normal level and measuring the exact height of any point on the land above it even by measurements many times repeated, it might well be attributed to some inaccuracy in the measurements if it were an isolated case. but it is not. Similar comparison of points on Lake

Ontario and on Lake Huron and Michigan also, indicate tilting, and tilting in the same direction as at Lake Erie and not only that but the amount corresponds with the distance apart of the two points compared. Furthermore the direction of the tilting indicated by these measurements is the same as that indicated by the dip of the old lake beaches. We are therefore forced to the conclusion that the basins of the great lakes have been considerably tilted and that this tilting has been going on in the present century. As the outlet of Lake Erie is at that end of the basin which has been raised more than any other part, the result has been to deepen the water throughout, but especially at the opposite end where the islands are situated. The spreading of the waters over the land should be here more noticeable for another reason also, viz.; because the shores are so low. We should therefore expect to find here in the form of submerged forests and other things that could not have formed under water, evidence of the spreading of the waters of the lake over the land, and so we do.

OLD TREES KILLED BY RISE OF THE WATER.

By the high water that prevailed in 1858 to 1860 large trees were killed in many places where the waves could not reach them. Mr. George Hine, who owns land bordering the marsh east of Sandusky, had hickory trees two feet in diameter killed in this way. On Kelley's Island large sycamore trees standing on the border of the south marsh, on Put-in-Bay elm and sycamore, on Middle Bass big trees growing by the marsh near Rehberg's, and at Toussaint and elsewhere along the shore between Port Clinton and Toledo old walnut trees, were killed at this time by high water keeping the ground too wet around their roots. Persons who came to Erie county in the forties remember seeing about the marshes connected with the bay many

dead trees which they believed to have been killed by high water, and old residents of Put-in-Bay and Kelley's Island have told me the same thing about trees there. It is probable that these trees were killed in 1838 when the water was nearly as high as in 1858, though it did not remain high so long. Hundreds of walnut stumps are still standing along the border of the marshes east of Sandusky where even now, although the water is lower than usual, it is too wet for walnut trees to grow. One that stood recently on ground only six inches above the present lake level measured 5 feet 4 inches in diameter. We may infer from this that during the life of this tree, probably over three hundred years, the water was not so high as in the present century.

SUBMERGED FORESTS.

Stumps and logs with roots attached have been found under water and show that when the trees grew the water must have been considerably lower than it has been during the present century. In the lake at Deisler's bathing beach, Put-in-Bay, was a sycamore stump that was dangerous to persons swimming, as it did not show above the water, and had to be blasted out. Other stumps in the water not far from where this one stood may still be seen. Near the Black Channel in Sandusky bay are cedar stumps standing upright with roots in place and completely submerged, except at such low stages of the water as rarely occur, when a little of the tops project. About a mile west of Venice many buried cedar stumps have been found below the level of the lake.

Besides stumps a large amount of submerged timber that fell without being cut has been found where it fell, and much of it is to be seen now. The greatest quantity is in the Huron marsh connected with Sandusky Bay. In parts where the water and mud are not very deep the logs may be easily seen in such numbers

and variety as to show that a forest was once there, but in the deeper water they are also abundant and are often struck by the pole of a hunter pushing his boat through the marsh. When in a very dry season, the ditch was dug through the marsh in order to float boats from the club house out to open water, logs of sassafras with the roots on, and a cedar with branches were found at the bottom, *i. e.* 3 or 4 feet below the present lake level. Even in the deeper parts a few logs are still to be seen partly above the water, having been supported by roots, or roots and branches until the marsh had grown up under them. A cedar out about 60 rods from land where the muck is five feet deep, has roots extending down into it at least three feet. It is 17 inches in diameter, and has about 60 rings. A pine log two feet in diameter and with 91 rings lies where the muck is over six feet deep. It has roots running down some distance and 30 years ago was not yet prostrate but the other end stuck up as much as seven feet above the water, and formed a landmark for fishermen. This is out about 80 rods from the present shore of the marsh. A walnut tree that forks into two huge and crooked branches whose ends are buried in the muck must have grown near where it lies, but this also, though a mile or more from the pine log, is some 80 rods out from shore, and the water at this place is now seven feet deep. It is still 23 inches in diameter and probably required nearly two centuries to grow. Observations on these trees were made March 5th and 6th, 1898, when the readings of the water gauge at Cleveland show the lake to have been 3½ feet lower than the high water mark. During the life of these trees the lake must have been at least eight feet lower than it has been during much of the time for the last forty years.

A great quantity of submerged timber still retaining roots and branches was removed from the water in

front of the club house on Put-in-Bay by Mr. Vroman. There were soft maple, oak and sycamore, some of the logs four or five feet in diameter.

SUBMERGED STALAGMITES.

In several of the caves at Put-in-Bay nearly half a mile from shore, is deep water which rises and falls with fluctuations in the level of Lake Erie. The floors of these caves are covered with stalagmites, and the roofs were formerly studded with stalactites. In three caves I have seen stalactites hanging down in the water and in two stalagmites rising in the water. In one cave about thirty stalagmites may be seen on a submerged floor of a few square rods extent. They are, most of them, nearly cylindrical in shape, and represent merely the cores of larger stalagmites which once probably formed a crust over the whole floor, the remainder having been dissolved away. Those in the deeper water appear to have been dissolved more than those in the shallower parts. Many were standing in water from 2½ to 3½ feet deep, March 12 and 13, 1898. As stalactites and stalagmites would not form under water, the water from which the calcium carbonate was precipitated to form them must have flowed to a lower level than where the lowest stalagmites now exist. We may therefore infer that during the period of their formation, which certainly lasted many years, and probably some centuries, the lake was at least five feet lower than the mean level of the past forty years.

If these caves were formed in preglacial times, the argument still holds good, for if the lake had been as high or higher than now ever since the melting of the glacier and stalagmites had existed in the caves then, they would have been dissolved long ago. The stalagmites visible now are evidently not preglacial. Where the water does not cover the floor of the caves they are forming at the present time.

RIVER CHANNELS BELOW THE LAKE LEVEL.

In the Huron marsh off the mouth of Plum Brook, a setting pole may be pushed down 12 feet. This may be done along a line extending from the mouth of the creek out into the marsh, but a few rods on either side the pole goes down only two or three feet. When the stream cut this channel Lake Erie must have been at least 12 feet lower. Not only has the lake spread its waters over all the lowland through which this creek formerly flowed, and other creeks, whose submerged channels could doubtless be found by searching, but it has extended far up into the valleys of all the streams. This effect must result from the rise of the lake, for the streams had cut their valleys below the general level of the country, though not below the level to which the water had to flow while the cutting was going on. The Portage, the Sandusky, the Huron, and the other so-called rivers as well as all the smaller streams that enter this part of the lake, have the lower portions of their valleys filled by the water of the lake. Into the valley of the Old Woman Creek the lake has extended two miles farther than the present shore line, into the valley of the Huron five miles measured in a straight line from the present shore, into the Sandusky 22 miles beyond the Cedar Point light house, and more than 25 miles measured in a straight line from Rye Beach, for it is probable that the Black Channel at the east end of what is now Sandusky Bay is a part of the old river channel, also that the "Harbor" between Marblehead and Catawba is part of the old valley of the Portage, the lake having spread over the land to the west of Catawba and made an opening for the river at Port Clinton. This is not as yet quite certain, but there is no uncertainty about the valley of the Huron; it is still uninterrupted from the village of Huron on the lake shore to the place five miles inland where the flowing stream meets the water of the lake. The valley was

cut by the river when its waters continued to descend to Huron and beyond, but this must have been when the lake was not less than 32 feet lower than now, for the bottom of the channel is 32 feet below the present lake level at a point more than four miles from the lake, and the depth of the water above the mud is between 17 and 32 feet all the way from this place to the lake.

Even Mud Creek, a small tributary of the Huron, has all the lower part of its channel deep below the present lake level. The entire drainage area of this creek is only about four square miles, yet its waters reach the present level of the lake nearly a mile measured along the valley of the stream above its junction with the Huron, and at a bridge about three-fourths mile up the valley the water and mud are 12 or 14 feet deep.

EVIDENCE OF THE WATER'S DEEPENING IN THE PRESENT CENTURY.

Records of the lake level kept at different places show that at four times in the first half of the century the water was lower than at any time in the last half. In 1810 and in 1819 it was lower than any time since 1820, in 1841 and 1846 lower than at any time since the latter date. In the absence of any record of exact measurement of lake levels west of Cleveland we have, nevertheless, evidence that the water about Sandusky and the islands was lower in the early part of the century. Mr. Shook, now living at Port Clinton, remembers that in 1828 Mr. Ramsdell made hay of the wild grass that grew on what is now the harbor west of Lakeside, and that there was very little water then where it has since been four feet deep. Similar statements are made by other persons regarding this and other places in this region.

When Harrison's army passed near Huron in 1813

a corduroy road about 60 rods long was built across Mud Creek bayou, which, it is said, had been submerged for many years, when, in 1867, the water being temporarily very low, Mr. Carpenter removed many of the logs.

A survey made in 1887 of the Huron marsh at the east end of Sandusky bay shows that a tract of land one-half mile square, surveyed in 1809 has since become marsh with the water and mud 12 to 18 inches deep, and for two miles west of it, as far as it was surveyed, the shore line has moved south about five rods. These changes are certainly *not* due to erosion. Elsewhere about Sandusky bay and along the shore of the lake land has disappeared, partly from erosion and partly because of the rising water covering it and giving the waves new points of attack. The western part of the city of Sandusky has suffered much from the encroachment of the bay and along nearly the whole shore west to Martin's Point and beyond land has disappeared. So it is also along the lake. The surveys show that for seven miles west from the Vermillion River the lake has encroached upon the land between 20 and 34 rods since 1809. From the Huron River to Dr. Esch's place, about one and one-half miles west, the shore line has moved south a distance varying from 18 to 28 rods, west of this not so much. Since 1809 more than 500 acres have been lost to Erie county along the lake and in the eastern part of the bay, and many acres more between Sandusky and the western limit of the county. On the north side of the bay, too, the water has extended, open water covering ground where cat-tails once grew. John Stone of Put-in-Bay, and Warren Smith of Sandusky, remember when rushes grew over much of Sandusky Bay where now is open water. Until the middle of the century an island known as Peninsula Point extended across nearly the whole breadth of what is now the mouth of the bay. For the

length of a mile its height was 20 to 25 feet or more, and along the west side was clay covered with six inches of black soil bearing shell bark hickory trees and white oaks two and one-half feet in diameter. The last of this large island disappeared in 1860.

Gull Reef, north of Kelley's Island, has for many years been the greater part of the time under water. As late as 1850 it was an island on which stood a fish shanty and a tree that probably took a hundred years to grow.

DERIVATION OF THE ISLAND FLORA.

The facts stated in the preceding paragraphs suggest the possibility of many of the plants now on the islands having spread over them when a land connection existed between them and the mainland. Mr. Gilbert and others have concluded from a study of the old lake beaches that when the melting of the ice to the north opened an outlet for the glacial lake at Niagara the waters went down till it occupied only one-sixth the area that Lake Erie does now, and extended no farther west than Erie, Pa. We have seen that the submerged forests and stalagmites in the region about Sandusky and the islands prove a lower condition of the water when these were formed than has existed in the present century, and that the submerged river channels in this region indicate that the depression of the land as compared with the water has amounted to not less than 32 feet. A lowering of the water 22 feet would make it possible to walk from Kelley's island to Catawba, and 30 feet from Put-in-Bay to Catawba, excepting for a narrow channel, like a river which is deeper than the rest. We would be entitled, therefore, to conclude, even without a knowledge of observations made in other regions, that the islands were connected with the mainland in postglacial times. With this conclusion it is much easier to harmonize the facts

ascertained regarding the plants now growing on the islands than to see how all of them could have been transported across several miles of water.

The seeds of many plants are provided with such means of transportation as would render their safe passage over a few miles of water an easy matter. Some produce fruit that is swallowed whole by birds and the pulp digested but not the seeds. The latter may thus be transported over land or water and propagate the species miles away from the parent plant. A mountain ash found growing on Rattlesnake Island in a thicket where birds roost was doubtless carried there in this manner. Some seeds like those of thistle have down so light that the wind may carry them long distances. Some are capable of floating for a time and then germinating. Some seeds are so small that they are likely to be carried in the mud that sticks to tne feet of rails or other birds that frequent marshy places. In several instances a single specimen of orchid has been found growing on some springy bank or damp place in the woods of Erie county and not another of the same kind within many miles. In two instances the single specimens are the only ones we have ever found in the county. These probably came from seeds that stuck to the feet of woodcocks or other birds that transported them from some distant bog. *Ammania coccinea* and some other mud-inhabiting species were probably transported in this way to the shore of Sandusky bay from much farther south for they are not known to grow elsewhere within more than a hundred miles.

When the ice forms a bridge between the islands and the mainland it would seem that weeds or their seeds might be blown across it or be carried across in the hair of animals. Seeds might also have been transported in former times by the Indians in their boats. In the present century the flora of the islands has been

materially increased through the agency of man. Several cultivated plants have run wild and become well established there, including several species which are seldom found flourishing in the wild state so far north. The islands seem to have their full share of weeds and most of these have probably been introduced with impure seed. Others have probably been transported in baled hay and in packing material, and some, like the hore-hound, by sticking to people's clothes.

So numerous are the ways in which seeds may be transported that it would seem quite possible for the islands in the course of a few thousand years to have acquired all the plants that grow on them without any closer connection with the mainland than now exists. When, however, we consider more carefully these means of transportation in relation to all the species on the islands, we find it difficult to understand how some of them could have reached the islands in any of these ways.

A tornado passing first over the land and then the islands might carry seeds of any sort, but it would require more than one tornado to distribute seeds to all the islands and if any of the islands owed part of their plants to this agency we should expect to find on them some species well distributed which do not grow on the other islands at all, but this is not the case, with the exception of some species recently introduced by man. Other winds would not be likely to carry so far any but the lightest of seeds. Violent winds coming from the south where the mainland is nearest are generally accompanied by rain.

Any plant whose seeds are safely transported in the alimentary canal of birds might reach the islands in this way. Of the species that grow in muddy or marshy places and produce small seeds likely to be transported in mud on the feet of woodcocks, etc., not

many occur on the islands and some of the islands have no places which such birds frequent.

Men who have often crossed the ice in winter say it would be impossible for seeds to be blown along on the ice all the way to the islands. Not only is the ice apt to be rough in many places, but it is crossed by numerous drifts of snow and is always intersected by long cracks in which seeds would lodge. Cakes of floating ice might transport seeds some distance, but would usually be prevented from landing them on distant shores by other ice getting in the way, and the freezing of the seeds to the floating ice would prevent them from blowing off. However, some littoral species may have reached the islands in this way. In those instances in which animals have succeeded in swimming so far, any seeds that were clinging to their hair at the start would probably be washed off on the way. Yet many species that rely upon mammals for transportation from place to place are there and give evidence of having been there longer than civilized man. These plants mature their seeds from four to six months before the ice would permit an animal to cross to the islands, and some of them have lost all their seeds by that time.

The following list gives the names of some of the plants on the islands whose seeds are adapted to transportation in the hair of animals: *Desmodium canescens, Desmodium paniculatum, Agrimonia eupatoria, Geum album, Geum virginianum, Circaea lutetiana, Osmorrhiza brevistylis, Osmorrhiza longistylis, Sanicula marylandica, Sanicula marylandica var. canadensis, Galium aparine, Galium boreale, Galium circaezans, Galium triflorum, Coreopsis trichosperma var. tenuiloba, Echinospermum virginicum.*

Colonel James Smith in the narrative of his captivity with the Indians, 1755–59, says: "These islands are but seldom visited; because early in the spring and

late in the fall it is dangerous sailing in their bark canoes; and in the summer they are so infested with various kinds of serpents, (but chiefly rattlesnakes,) that it is dangerous landing." It is not probable then that the Indians planted anything there, or that any great number of seeds were introduced by them accidentally.

The difficulty of seeds floating to the islands is two-fold. The prolonged soaking in the absence of definite currents to carry them in that direction is sufficient to destroy the vitality of many kinds. The shores of the islands do not afford conditions suited to the growth of many of the species found in the interior. On Green and Rattlesnake islands there is not a single spot where it seems possible for a plant to start from seeds washed ashore, except such as grow on bare rocks. Six kinds of oak and three of hickory grow on the islands. If all these kinds came from nuts that drifted ashore, one would expect to find somewhere on the shore of some island a tree so situated as to suggest the possibility of its having originated in this way, but not a single one has been found. These are long lived trees, and if within the period represented by the growth of a large oak or hickory, there has not been a single instance of a nut drifting ashore and finding a suitable place to grow it may well be doubted, if in several thousand years there would be opportunities for all the different kinds to reach so many different islands. The fact that acorns left in the water soon lose their power to germinate increases the difficulty, yet it is not easy to see how, except by floating, acorns or pig-nuts would be likely to reach the islands as long as they were separated from the mainland as far as they are now.

The weeds that have followed civilized man from the Old World, or have spread since the cultivation of the land from other parts of this, grow on

the islands as well as the mainland. That they have reached the islands mainly through man's agency is shown by the fact that those islands which have the most extensive commerce have the greatest variety of weeds. Green Island, being still wild, may be left out of consideration, but the greater part of Rattlesnake is cultivated, and there many kinds of weeds grow with a luxuriance that tries the patience of the owner. Yet there are fourteen kinds of weeds that grow on all four of the other islands, which are not to be found on Rattlesnake, without counting a number that need a damper soil than there prevails. Not only are most of these fourteen common on all the islands that enjoy much commerce, but among them are included a number of the most abundant weeds in this part of North America. The list is as follows: *Lepidium virginicum*, *Abutilon avicennæ*, *Melilotus alba*, *Medicago lupulina*, *Bidens frondosa*, *Sonchus asper*, *Xanthium canadense var. echinatum*, *Marrubium vulgare*, *Amarantus albus*, *Amarantus blitoides*, *Acalypha virginica*, *Juncus tenuis*, *Bromus secalinus*, *Panicum sanguinale*. Why are these species, elsewhere so abundant, not represented on Rattlesnake Island? For many years the island has been cultivated and the conditions suitable to the growth of these fourteen kinds of weeds, most of which have abounded for many years all around Lake Erie, but the island has been the abode of only a single family and its commerce, therefore very limited, and the seeds have not found any way to reach the island, or, if they floated to it, no way to get up onto soil where they could grow.

If a large portion of the plants on the islands have reached them in ways which may be called accidental and not by means that may be seen operating in the present century, then we ought to find deficiencies in the flora of certain islands due to the failure of certain species to reach them. Some plants that are well

distributed on certain islands should be altogether wanting on others where the conditions for their growth are just as suitable. Moreover we should expect to find that some species not adapted to passing over the water had failed to reach any of the islands. But what we do find is the reverse. Every native species that is well distributed in similar soil on the mainland grows also on the islands and in no case, we believe, is a native species common over one island and lacking on others where similar conditions exist.

The leading facts bearing on the origin of the island flora may be summarized as follows: Within the present century the waters of Lake Erie and of the bays and marshes connected with it have encroached upon the land in the vicinity of Sandusky, covering many hundreds of acres of what was, at the time of the first surveys, solid ground. Trees several centuries old have been killed by high water in the present century. Submerged forests have been found in different parts of the region, submerged stalactites and stalagmites in the caves of Put-in-Bay, and submerged river valleys both east and west of Sandusky. When the trees grew and the stalagmites and valleys were formed, the land must have been above the level of the lake. The valleys are now deeper below the surface of the lake than is the lake bottom between the islands and the mainland. At the time they were formed, therefore, the lake did not separate the islands from the mainland. The flora of the islands is different from what we should expect to find, if all the species growing there had reached them by being transported across the water. It is probable then that many species have been on the islands since a time when these formed part of the mainland.

We may picture to ourselves woods such as grow at Lakeside now stretching north to Put-in-Bay and Kelley's island, interspersed here and there with prairies, perhaps, like those on the Peninsula now. We may

well believe the picture to represent what was once a reality. How long ago this was we cannot tell. Some observations make it seem probable that it was not a great many centuries ago, perhaps less than twenty. Sometime we may find better means of judging.

SOUTHERN AND WESTERN PLANTS WHICH GROW NEAR LAKE ERIE.

Owing to the long summer enjoyed by places situated on the south shore of Lake Erie, many plants grow here which are not found farther north. As the country farther east lacks prairies such as occupy a considerable part of Erie county, quite a number of species appear to reach their eastern limit here. Since a number of the species are both southern and western, no separation of southern and western species is attempted in the following list. Many of the southern species grow east of the southern part of Lake Michigan. and some of them in southern Minnesota, where the summer isotherms reach a higher latitude than in the eastern part of the country. The species in the list are believed to be wholly wanting or of rare or local occurrence in that part of North America, which lies east and north of the meridian and parallel of Cleveland. Few of them are found in northern Ohio anywhere east of Erie county. The plants whose names are followed by an asterisk I have not found, but Mr. David F. Day, of Buffalo, who collected at Toledo in 1865, tells me that he found them there.

Echinacea purpurea is inserted in the list because of a Toledo specimen in the herbarium of the Ohio State University.

Viola pedatifida.
Hypericum gymnanthum.
Hibiscus militaris.*
Aesculus glabra.
Polygala verticillata ambigua.
Desmodium lineatum.
Desmodium illinoense.
Petalostemon candidus.*

Silphium trifoliatum.
Solidago speciosa angustata.
Vernonia altissima.
Asclepias sullivantii.
Petalostemon violaceus.*
Psoralea melilotoides.
Geum vernum.
Pyrus angustifolia.
Spiræa lobata.
Ammannia coccinea.
Eryngium yuccæfolium.
Thaspium barbinode angustifolium
Valeriana pauciflora.
Actinella acaulis glabra.
Aster shortii.
Coreopsis aristosa.
Echinacea purpurea.
Eclipta alba.
Eupatorium altissimum
Helianthus grosse-serratus.
Helianthus hirsutus.
Helianthus mollis.
Helianthus occidentalis.
Helianthus parviflorus.
Helianthus tracheliifolius.
Kuhnia eupatorioides.
Liatris pycnostachya.*
Liatris squarrosa intermedia.
Prenanthes aspera.
Prenanthes crepidinea.
Rudbeckia triloba.
Phlox maculata.*
Hydrophyllum macrophyllum.
Phacelia purshii.
Cuscuta chlorocarpa.
Cuscuta decora.
Conobea multifida.
Gerardia auriculata.
Gratiola sphaerocarpa.
Seymeria macrophylla.
Tecoma radicans.
Lippia lanceolata.
Pycnanthemum muticum pilosum.
Scutellaria nervosa.
Scutellaria versicolor.
Euphorbia dentata.
Salix glancophylla.
Iris cristata.
Smilax ecirrhata.
Trillium sessile.
Carex conjuncta.
Carex shortiana.
Carex stenolepis.
Carex granularis haleana.
Carex mnhlenbergii enervis.
Cyperus refractus.
Rhynchospora cymosa.
Aristida gracilis.
Melica diffusa.
Poa brevifolia.
Triodia cuprea.
Equisetum robustum.

A "List of Plants Observed Growing Wild in the Vicinity of Cincinnati," by C. G. Lloyd, with additions furnished by Walter H. Aiken, includes six hundred and forty-five species and varieties. Of these only fifty-one native species are lacking in Erie county. A greater number than this have been found in Lorain county, which borders Erie on the east, and might probably be found in each of the lake counties beyond.

DEFICIENCIES IN THE SANDUSKY FLORA.

Of the four counties, Lorain, Cuyahoga, Franklin and Licking, each two or three times as large as Erie, lists of plants have been published. Several hundred species are common to the four counties. Only four of these species, *Viola canadensis, Hieracium venosum, Veronica americana and Habenaria orbiculata*, have we failed to find in Erie county.

However twenty-five species not found in Erie county, grow in both Lorain and Cuyahoga. If we had complete lists for the counties farther east, Lake and Ashtabula, we should probably find in them a still larger number that do not grow in Erie county. Their higher hills and deeper ravines, give them a more northern flora, than one finds in the neighborhood of Sandusky. Moreover the Sandusky district contains no genuine bog or sphagnous swamp. Such a bog encircles a little lake a few miles south-east of Erie county in Camden township, Lorain county. The list of plants growing at Camden Lake and not in Erie county, is probably incomplete. For some of the names, I am indebted to Isabel S. Smith who has found the specimens in the Oberlin herbarium.

The list of other plants growing in northern Ohio is based mainly on the work of other collectors. It includes only those species which are said to grow in two or more counties bordering on the Lake. Of some of the species I have seen no specimens. Many other species have been reported and many others undoubtedly grow in one place or another, but this list together with the catalogue of plants of Sandusky and vicinity and the plants of Camden are thought to include all the native phenogams and vascular cryptogams which grow in the Lake counties, excepting such as are very rare or local.

PLANTS GROWING AT CAMDEN LAKE.

Coptis trifolia.
Sarracenia purpurea.
Nemopanthus fascicularis.
Potentilla palustris.
Viburnum cassinoides.
Cassandra calyculata.
Vaccinium oxycoccus.
Menyanthes trifoliata.
Alnus serrulata.
Arethusa bulbosa.
Habenaria orbiculata.
Pogonia ophioglossoides.
*Smilacina trifolia.
Calla palustris.
Peltandra undulata.
Scheuchzeria palustris.
Carex canescens.
Carex debilis.
Carex trisperma.
Eriophorum virginicum album.
Rhynchospora alba.
Glyceria canadensis.
Woodwardia virginica.

OTHER PLANTS NOT FOUND NEAR SANDUSKY, BUT SAID TO GROW IN TWO OR MORE OF THE COUNTIES OF OHIO THAT BORDER ON LAKE ERIE.

Adlumia cirrhosa.
Corydalis glauca.
Stylophorum diphyllum.
Viola canadensis.
Viola hastata.
Viola rotundifolia.
Acer spicatum.
Polygala polygama.
Astragalus cooperi.
Prunus pennsylvanica.
Waldsteinia fragarioides.
Ribes oxyacanthoides.
Ribes rubrum subglandulosum.
Saxifraga virginiensis.
Oenothera biennis grandiflora.
Aralia hispida.
Diervilla trifida.
Lonicera ciliata.
Cornus canadensis.
Antennaria margaritacea.
Aster patens.
Cacalia suaveolens.
Hieracium venosum.
Polymnia uvedalia.
Solidago squarrosa.
Solidago uliginosa.
Pyrola secunda.
Rhododendron nudiflorum.
Vaccinium stamineum.
Monotropa hypopitys.
Phlox maculata.
Cynoglossum virginicum.
Melampyrum americanum.
Pentstemon laevigatus digitalis.
Veronica americana.
Rumex salicifolius.
Myrica asplenifolia.
Alnus incana.
Betula lutea.
Cypripedium parviflorum.
Pogonia verticillata.
Spiranthes latifolia..
Smilax glauca.
Uvularia perfoliata.

Veratrum viride.
Carex umbellata.
Cyperus erythrorhizos.
Milium effusum.
Larix americana.
Asplenium trichomanes.
Ophioglossum vulgatum.
Phegopteris polypodioides.
Woodsia obtusa.

EXTINCT SPECIES.

The only plant no longer found in the county, but known to have formerly grown in considerable quantity, is the Pitcher Plant, *Sarracenia purpurea* Mr. W. H. Todd remembers that this used to grow in the old huckleberry swamp near Axtell, in the eastern part of the county. This swamp of a hundred acres extent, is said to have produced yearly hundreds of bushels of blueberries, and a hundred bushels or so of cranberries. About 1856 a fire started in the muck, which lasted for a year, burning in places to a depth of four to six feet. This and drainage killed all the cranberries and nearly all the blueberries, and, how many other species, no body will ever know. It is now overgrown with a dense tangle of blackberry bushes interspersed with aspen and soft maple; the soil too light to be of much account. Had the original swamp been preserved, it would now be valuable for the berries it would produce. Only after repeated visits and prolonged searching in this wilderness by several persons, were two surviving bushes of the swamp blueberry discovered. Cranberries, which formerly grew also in a swamp near Berlin Heights, are now confined to a few square yards of ground, along a road near Milan.

Poison sumach formerly grew in the Axtell swamp. It is now all but extinct in the county. Leatherwood formerly abounded on Beecher's flats along the west branch of the Vermillion River. A single specimen remains, probably the only one in the county. A sedge collected on Cedar Point several years ago, and called by Prof. Wheeler, Cyperus Houghtonii, was afterward lost and so is not included in our catalogue. Likewise

we omit Strawberry Blite, *Chenopodium capitatum*, seen on Green Island in 1892, but not collected, and Hedeoma hispida, given in a list of plants, analyzed in the eastern part of Erie county by Josephine Fish, a number of years ago. The last has been found in Lorain County by Prof. Kelsey, but perhaps is not indigenous to Ohio.

FOREST TREES.

Most of the land of Erie county is now under cultivation. Much of it was treeless when the earliest settlements were made. Nevertheless, it supports a greater variety of trees than do most of the counties of Ohio, greater, perhaps, than any similar area farther north in America. Birch, alder and tamarack, which grow farther east in Ohio, are lacking in Erie county, but it has ten kinds of oak, six of hickory, five of ash, four of maple, four of poplar, four of willow, three of thorn, two of elm, two of ironwood, two of wild crab, and one each of black cherry, chokecherry, plum, juneberry, basswood, box elder, buckeye, staghorn sumach, papaw, tulip, cucumber, red-bud, locust, coffee-tree, dogwood, pepperidge, sassafras, mulberry, hackberry, buttonwood, beach, chestnut, walnut, butternut, hemlock, cedar and pine. Besides these, there are several cultivated kinds that have become naturalized. The distribution is given in the catalogue, where the names may be found by referring to the index. Erie county has five times as many native trees as the whole of Great Britain.

THE CATALOGUE.

The catalogue that follows gives the names of the phenogams and vascular cryptogams in the herbarium of the Sandusky high school which have been collected in the region shown on the accompanying

map, i. e. Erie county, and the islands of Ottawa county, with the eastern portion of the peninsula, extending as far west as Port Clinton. Specimens of all the species and varieties have been examined by Prof. C. F. Wheeler, of Michigan, to whom I am indebted also for assistance in the determination of my earlier collections of Cyperaceæ and Naiadacæ, as well as of many puzzling forms found since.

Furthermore, a collection of most of the rarer species has been deposited in the Gray Herbarium, Cambridge, Mass., and another set in the Ohio State Herbarium, at the University at Columbus, and at both places botanists have examined them to see if there were errors in the identification.

To Dr. Erwin F. Smith, of Washington, I am also indebted for valuable suggestions and assistance.

In a region where so many rare native species occur one would expect to find some exotic plants thriving, better than in most places in this latitude. As in the Philippine Islands where it has been introduced, so also in Sandusky, the tomato grows wild, coming up like a weed in many places, but especially along the bay shore, where it ripens its fruit year after year. It is difficult in some cases to say whether a species is naturalized or not. Oats grow on the shores of the islands, as well as about the docks in Sandusky, and along roads, but herbs of which all the specimens found have probably sprung directly from the seeds of cultivated plants, are not included in the catalogue. A watermelon vine with fruit was found on the shore of Cedar Point, and this and muskmelon, squash and pumpkin, on waste ground in Sandusky near the Bay. Peanuts, which are raised in small quantities by many people in and near Sandusky, have been found spontaneous in two places in the city. Snapdragon, ~~gilliflower~~ [illegible], candytuft, common honesty, petunia, and others, have been found growing in waste places, but

are excluded from the catalogue under the rule given above. On the other hand plants that are never cultivated in this region are included, even if merely adventive.

In nomenclature I have, in the main, followed the Index Kewensis, giving in parenthesis the names used in the sixth edition of Gray's Manual, in the few cases where those differ materially from the names of the Kew Index. Names of species not native to this part of the world, are printed in italics. An asterisk indicates that the species is at present known to grow in few, if any places in Ohio, except in the neighborhood of Sandusky.

Relative abundance is expressed by the following terms in the order named; rare, scarce, infrequent, frequent, common, abundant. When standing alone or coming first, they refer to Erie county as a whole.

CATALOGUE.

PTERIDOPHYTA.

OPHIOGLOSSACEÆ.

BOTRYCHIUM, Swartz.

B. TERNATUM, Swartz.
Eastern Milan, Berlin, Florence, Vermillion; infrequent. Varies greatly.

B. VIRGINIANUM, Swartz.
Frequent. Put-in-Bay.

FILICES.

ADIANTUM, L.

A. PEDATUM, L. Maiden-hair Fern.
Common. Not on the Islands.

ASPIDIUM, Swartz.

A. ACROSTICHOIDES, Swartz. Shield Fern.
Scarce in Perkins. Common on high banks of Huron and Vermillion Rivers.

A. CRISTATUM, Swartz.
Vermillion River bottoms, Florence; rare.

A. GOLDIANUM, Hook.
Florence and Kromer's woods, Perkins; scarce.

A. MARGINALE, Swartz.
Common on steep river banks.

A. NOVEBORACENSE, Swartz.
Infrequent.

A. SPINULOSUM, Swartz.
Frequent in rich woods.

A. SPINULOSUM INTERMEDIUM, D. C. Eaton.
Frequent. Neither this nor the species seen on Peninsula or Islands.

A. THELYPTERIS, Swartz.
Common.

ASPLENIUM, L. Spleenwort.

A. ANGUSTIFOLIUM, Michx.
Infrequent.

A. EBENEUM.
Common in Furnace woods, Vermillion, "Cedar Point," J. R. Schacht.

A. FILIX-FOEMINA, Bernh.
Common. Not on Peninsula or Islands.

A. THELYPTEROIDES, Michx.
Perkins and Florence ; scarce.

CAMPTOSORUS, Link, Walking-fern.

C. RHIZOPHYLLUS, Link.
On sides of sandstone rocks, Vermillion River, S. Florence ; on limestone, three places in Margaretta, Catawba, Kelley's sland.

CYSTOPTERIS, Bernh, Bladder Fern.

C. BULBIFERA, Bernh.
Frequent. Islands.

C. FRAGILIS, Bernh.
Common. Kelley's Island.

DICKSONIA, L'Her.

D. PILOSIUSCULA, Willd.
Vermillion River ; frequent. Big woods, Perkins ; scarce.

ONOCLEA, L.

O. SENSIBILIS L. Sensitive Fern.
Common. Not on the Islands.

O. STRUTHIOPTERIS, Hoffman.
Vermillion River bottoms, frequent.

OSMUNDA, L.

O. CINNAMOMEA, L. Cinnamon Fern.
Infrequent; Florence, Milan "Perkins."

Q. CLAYTONIANA, L.
Common in moist woods. Not on Peninsula or Islands.

O. REGALIS, L. Flowering Fern.
Infrequent in wet woods.

PELLÆA, Link, Cliff-Brake.

P. ATROPURPUREA, Link.
Sandstone quarry, Furnace woods, Vermillion; on limestone, Margaretta, Peninsula, Catawba, Kelley's Island, Put-in-Bay.

PHEGOPTERIS, Fee, Beech Fern.

P. HEXAGONOPTERA, Fee.
Frequent from the Huron river east.

POLYPODIUM, L., Polypody.

P. VULGARE, L.
Rocky banks of rivers and Kelley's Island; scarce.

PTERIS, L.

P. AQUILINA, L., Common Brake.
Frequent.

EQUISETACEÆ.

EQUISETUM, L., Horsetail.

E. ARVENSE, L.
Common but not observed on the Islands, except Kelley's.

E. LAEVIGATUM, Braun.
Frequent, at least in the western part of the county.

E. LIMOSUM, L.
Lake marshes, Huron Tp.

E. LITTORALE, Kuhl.*
Perkins; rare.

E. PRATENSE, Ehrh.
Frequent.

E. ROBUSTUM, Braun,
Common, apparently entirely supplanting E. *hyemale*. Put-in-Bay and Kelley's Island but no others

E. VARIEGATUM, Schleicher,*
Cedar Point and elsewhere; rare.

LYCOPODIACEÆ.

LYCOPODIUM, L., Club-Moss.

L. COMPLANATUM, L. Ground-Pine.
East fork of Vermillion River; rare.

L. DENDROIDEUM, Michx.
East of Milan; rare.

L. LUCIDULUM, Michx.
Quarry in Furnace woods, Vermillion; rare.
Each of the three kinds of club-moss has been found in but a single spot, and of the last two, only a few specimens.

GYMNOSPERMÆ.

CONIFERÆ.

JUNIPERUS, L.

J. COMMUNIS, L.
Mr. Latham's woods, Catawba; very rare.

J. VIRGINIANA, L., Red Cedar.
Frequent in dry soil in various parts of Erie and Ottawa counties. Formerly abundant on the islands where its wood was one of the first sources of income to the early settlers. Many stumps two feet or more in diameter still remain on Kelley's Island, though they are being used for kindling and for boat knees. The trees grew in the thin soil overlying the limestone, and so the roots following the level surface of the rock were given off from the trunk at a right angle. Having greater strength than an artificial joint and great durability sections of these stumps make excellent knees for small boats. Large cedars grew formerly also on Cedar Point where small ones are common now.

PINUS, Tourn.

P. STROBUS, L. White Pine.
Cedar Point and Vermillion River. Both this and Red Cedar grew once where Sandusky Bay is now.

TAXUS, Tourn.

T. CANADENSIS, Willd. American Yew. Ground Hemlock.
Shores of Islands and Vermillion River; infrequent.

TSUGA, Carriere.

T. CANADENSIS, Carr. Hemlock.
Common along the Old Woman Creek at Berlin Heights and along the Vermillion River.

MONOCOTYLEDONES.

TYPHACEÆ.

SPARGANIUM, Tourn, Bur-reed.

S. ANDROCLADUM. Engelm.
  Lake marshes. Middle Bass.

S. EURYCARPUM, Engelm.
  Lake marshes. Middle Bass.

S. SIMPLEX, Huds.
  Southern Florence, Shinrock.

TYPHA, Tourn.

T. AUGUSTIFOLIA, L.
  Castalia stream, Portage River and North Bass; scarce.

T. LATIFOLIA, L. Common Cat-tail.
  Common.

NAIADACEAE.

NAIAS, L., Naiad.

N. FLEXILIS, Rostk, and Schmidt.
  Common.

N. FLEXILIS ROBUSTA, Morong.*
  Infrequent.

N. GRACILLIMA, A. Br.*
  "Portage River" A. J. Pieters.

POTAMOGETON, Tourn. Pond-weed.

P. AMPLIFOLIUS, Tuckerm, Deep water; infrequent.

P. FOLIOSUS, Raf.
  East Harbor, Put-in-bay, North Bass; mostly in shallow water.

P· FOLIOSUS NIAGARENSIS, (Tuckerm.) Morong.*
  North Bass and small streams in Erie County, especially Mills Creek.

P. FRIESII, Rupr.*
Sandusky Bay, Put-in-Bay; infrequent.

P. HETEROPHYLLUS, Schreb.*
Frequent; especially the variety *longipedunculatus.* The variety *maximus* occurs at North Bass.

P. HILLII, Morong.*
East Harbor; rare.

P. INTERRUPTUS, Kitaibel.*
Sandusky Bay, Put-in-Bay; rare.

P. LONCHITES, Tuckerm.
Common.

P. LUCENS, L.*
Frequent.

P. NATANS, L.
Common, as is also the socalled variety, *prolixus.*

P. PECTINATUS, L.
Abundant-

P. PERFOLIATUS, L.
Frequent.

P. PERFOLIATUS RICHARDSONII A. Bennett.
Abundant.

P. PRAELONGUS, Wulf.*
Sandusky Bay, August Guenther. Perhaps its habit of withdrawing beneath the water, as soon as its fruit is set, has prevented us from finding much of it.

P. PUSILLUS, L.*
Infrequent.

P. ROBBINSII, Oakes.
Sandusky Bay; scarce.

P. ZIZII, Roth.*
Sandusky Bay; scarce.

P. ZOSTERÆFOLIUS, Schum.
Common.

TRIGLOCHIN, L. Arrow-Grass.

T. PALUSTRE, L.*
Castalia Sporting Club grounds; rare.

[illegible]

VALLISNERIA, L. Tape-Grass, Eel-Grass.

SPIRALIS, L.
Common.

GRAMINEÆ.

AGROPYRON, Gaert.

. CANINUM, Beauv.*
Berlin Heights; rare.

A. GLAUCUM, R. & S.*
L. S. & M. S. Ry., Sandusky; scarce.

A. REPENS, Beauv. Couch-Grass, Quitch-Grass.
Infrequent. Kelley's Island.

AGROSTIS, L. Bent-Grass.

A. ALBA, L.
Common, as is the variety *vulgaris*, Red Top.

A. PERENNANS, Tuckerm, Thin-Grass.
Frequent.

A. SCABRA, Willd. Hair-Grass.
Infrequent. Put-in.Bay, Middle Bass.

ALOPECURUS, L. Foxtail-Grass.

A. GENICULATUS ARISTULATUS, Torr.
Islands, Peninsula and Milan; rare in Erie county.

AMMOPHILA, Host.

A. ARUNDINACEA, Host. Sea Sand-Reed.
Cedar Point and Marblehead Sand Spit.

ANDROPOGON, L. Beard-Grass.

A. PROVINCIALIS, Lam. (A. FURCATUS, Muhl.)
Frequent.

A. SCOPARIUS, Michx.
Frequent. Not observed in Ottawa county.

ZANNICHELLIA, Mitchell, Horned Pond-Weed.

Z. PALUSTRIS.
The "variety" *pedunculata* grows, or did grow in one of the rivulets flowing from the Blue Hole, Castalia; rare.

ALISMACEÆ.

ALISMA, L. Water-Plantain.

A. PLANTAGO, L.
Common.

LOPHOTOCARPUS, T. Durand.

L. CALYCINUS, (Engelm) J. G. Smith.*
In a small pond bordering the southern boundary of Sandusky.

SAGITTARIA, L. Arrow-Head.

S. ARIFOLIA, Nutt.
Oxford, Danbury; scarce.
S. GRAMINEA, Michx.*
Sandusky Bay. "East Harbor," A. J. Pieters.
S. LATIFOLIA, Willd. (S. VARIABILIS, Engelm.)
Common and variable.
S. RIGIDA, Pursh. (S. HETEROPHYLLA, Pursh.)
Sandusky Bay, Put-in-Bay, Harbors; frequent. In deeper water than the last.

HYDROCHARIDACEÆ.

ELODEA, Michx. Water-Weed.

E. CANADENSIS, Michx.
Common. Kelley's Island, Put-in-Bay. Filling the cove east of Sandusky so as to make it difficult to row a boat there.

VALLISNERIA, L. Tape-Grass, Eel-Grass.

V. SPIRALIS, L.
Common.

GRAMINEÆ.

AGROPYRON, Gaert.

A. CANINUM, Beauv.*
Berlin Heights; rare.
A. GLAUCUM, R. & S.*
L. S. & M. S. Ry., Sandusky; scarce.
A. REPENS, Beauv. Couch-Grass, Quitch-Grass.
Infrequent. Kelley's Island.

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Common, as is the variety *vulgaris*, Red Top.
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Islands, Peninsula and Milan; rare in Erie county.

AMMOPHILA, Host.

A. ARUNDINACEA, Host. Sea Sand-Reed.
Cedar Point and Marblehead Sand Spit.

ANDROPOGON, L. Beard-Grass.

A. PROVINCIALIS, Lam. (A. FURCATUS, Muhl.)
Frequent.
A. SCOPARIUS, Michx.
Frequent. Not observed in Ottawa county.

ARISTIDA, L. Triple-awned Grass.

A. GRACILIS, Ell.*
Unplowed prairle, Perkins.

A. PURPURASCENS, Poir.*
Roadside, Joseph Smith's, Perkins.

ASPERELLA, Humb. Bottle-brush Grass.

A. HYSTRIX, Humb.
Common.

BOUTELOUA, Lag. Muskit-Grass.

B. RACEMOSA, Lag.
Castalia cemetery and southwest, Marblehead ; dry ground ; scarce.
Our forms approach the variety *aristosa*.

BRACHYELYTRUM, Beauv.

B. ERECTUM, Beauv. (B. ARISTATUM R. & S.)
Frequent.

BROMUS, L. Brome-Grass.

B. CILIATUS, L.
Common. Kelley's Island., Rattlesnake Island. The variety *purgans* also common, but not on the Islands.

B. KALMII, Gray. Wild Chess.
Margaretta Ridge ; rare.

B. *racemosus*, L. Upright Chess.
Common.

B. *secalinus*, L Cheat or Chess.
Not so common as the last.

B. *tectorum*, L.
Along Big Four Ry., Sandusky and Castalia ; elsewhere also, but scarce.

CENCHRUS, L. Hedgehog or Bur-Grass.

C. TRIBULOIDES, L.
Common in sand.

CHRYSOPOGON, Trin.

C. NUTANS, Benth, Indian Grass, Wood Grass.
Frequent.

CINNA, L. Wood Reed-Grass.

C. ARUNDINACEA, L.
Frequent.

DACTYLIS, L. Orchard-Grass.

D. *glomerata*, L.
Frequent.

DANTHONIA, D C. Wild Oat-Grass.

D. SPICATA, A. & S.
Common. Not on Islands, except Put-in-Bay.

DEYEUXIA, Raf.

D. CANADENSIS, Beauv. Blue-Joint Grass.
Frequent. Middle Bass, North Bass.

EATONIA, Raf.

E. OBTUSATA, Gray.*
Infrequent. Margaretta Ridge, Marblehead, North Bass, etc.

E. PENNSYLVANICA, Gray.
Frequent. Islands.

E. PURPURASCENS Raf. (E. DUDLEYI, Vasey. E. NITIDA Nash.)
Florence, and Furnace woods, Vermillion.

ELEUSINE, Gaertn.

E. *indica*, Gaertn. Dog's-tail or Wire Grass.
Formerly seldom seen, but now common along many sandy lanes.

ELYMUS, L. Lyme-Grass, Wild Rye.

E. CANADENSIS, L.
Frequent, especially on sand beaches. Islands. The so called variety *glaucifolius* occurs in a number of places but does not appear at all distinct.

E. STRIATUS, Willd.
Infrequent. Kelley's Island. The so called variety *villosus* was found in Perkins.

E. VIRGINICUS, L
Frequent along streams and shores of the Islands.

ERAGROSTIS, Host.

E. CAPILLARIS, Nees.
Willow Point, Margaretta and different parts of the Peninsula.

E. FRANKII, Steud.
Perkins, Castalia, Lockwood's woods, Catawba.

E. *major*, Host.
Abundant.

E. PURSHII, Schrader.
Common in Erie Co., especially along railroads. Kelley's Island.

E. REPTANS, Nees.
Infrequent.

E. SPECTABILIS, Steud.* (E. PECTINACEA SPECTABILIS, Gray) Lake sands of Cedar Point, Marble-head Spit, and Port Clinton; local.

FESTUCA, L. Fescue-Grass.

F. *elatior*, L. Meadow Fescue.
Common. The variety *pratensis* common in Sandusky and along some country roads.

F. NUTANS, Spreng.
Common. Not noticed on Kelley's sland.

F. TENELLA, Willd.
Marblehead, Cedar Point and east of Milan.

GLYCERIA, R. Br. Manna Grass.

G. FLUITANS, R. Br.
Infrequent. Islands.

G. NERVATA, Trin.
Common.

G. PALLIDA, Trin.
Port Clinton; rare.

HIEROCHLOE, S. G. Gmel.

H. BOREALIS, R. & S.
"Perkins" Elon House.

HORDEUM, L.

H. JUBATUM, L. Squirrel-tail Grass.
Common along L. S. & M. S. Ry. in Ottawa Co. Blue Hole, Castalia. Kelley's Island, where probably introduced in baled hay. Marblehead.

KOELERIA, Pers.

K. CRISTATA, Pers.*
Catawba, where first found by A. D. Selby. Margaretta Ridge, Oxford; also ten miles west of Toledo.

LEERSIA, Swartz.

L. ORYZOIDES, Swartz. Rice Cut-grass.
Common.

L. VIRGINICA, Willd. White Grass.
Common but not noticed on any island except Kelley's.

LOLIUM, L.

L. *perenne*, L. Common Darnel, Ray or Rye-Grass.
Sandusky, Soldier's Home, Kelley's Island, Put-in-Bay; infrequent. Not noticed until 1897.

MELICA, L. Melic-Grass.

M. DIFFUSA, Pursh.*
Castalia; rare.

MUHLENBERGIA, Schreb. Drop-seed Grass.

M. GLOMERATA, Trin.*
West of Castalia; rare; also ten miles west of Toledo.

M. MEXICANA, Trin.
Common.

M. SCHREBERI, J. F. Gmel. (M. DIFFUSA, Schreb.)
Common.

M. SOBOLIFERA, Trin.*
Florence, Catawba; rare.

M. SYLVATICA, Torr. & Gray.
Perkins, Florence, Middle Bass; infrequent.

M. WILLDENOWII, Trin.
Vermillion River, Huron, Milan, Perkins, Margaretta Ridge; infrequent.

ORYZOPSIS, Michx. Mountain Rice.

O. MELANOCARPA, Muhl.
Margaretta Ridge, Vermillion River, Put-in-Bay; rare.

PANICUM, L. Panic-Grass.

P. AGROSTOIDES, Muhl.
Huron, Milan, Oxford, Perkins, North Bass; local.

P. BARBULATUM, Michx.
Berlin; rare.

P. CAPILLARE, L. Old-witch Grass.
Common.

P. CLANDESTINUM, L.
Cedar Point, Perkins, and common along river channels.

P. COLUMBIANUM, Scribn.
Castalia, Cedar Point. Formerly called P. *dichotomum*.

P. *crus-galli*, L. Barnyard-Grass.
Abundant.

P. CRUS-GALLI HISPIDUM, Muhl.
Frequent on wet ground about Sandusky Bay and East Harbor.

P. DEPAUPERATUM, Muhl.
Catawba and high banks of Vermillion River and Old Woman Creek.

P. DICHOTOMUM, L.

Common and variable, the so called variety *gracile*, found only at Berlin Heights, seeming most distinct from other forms.

P. FLEXILE, Scribn.

Castalia prairie; common. Oxford.

P. *glabrum*, Gaudin. Small Crab-Grass.

Common. North Bass the only island.

P. LATIFOLIUM, L.

Common in Erie County.

P. MILIACEUM, L. Millet.

Adventive. "Cedar Point," E. Claassen. Sandusky near the Bay, one specimen growing on rubbish.

P. PROLIFERUM, Lam.

Sandusky, Oxford; rare.

P. PUBESCENS, Lam.

Common in Erie County.

P. *sanguinale*, L. Large Crab-Grass.

Abundant.

P. SCOPARIUM, Lam.

Oxford, Margaretta, Cedar Point, Port Clinton; common.

P. VIRGATUM, L.

Frequent. Kelley's Island. Abundant on sandy shores of Lake Erie.

PASPALUM, L.

P. SETACEUM, Michx.

Dell Lindsley's orchard, Perkins, where it has probably been for many years.

PHALARIS, L.

P. ARUNDINACEA, L.

Cedar Point, Huron, western Margaretta, Middle Bass; infrequent. The variety *picta* Ribbon-Grass, has become established along some road-side ditches.

P. *canariensis*, L. Canary-Grass.

Adventive in Sandusky.

PHLEUM, L.

P. *pratense*, L. Timothy.
Abundant.

PHRAGMITES, Trin. Reed.

P. COMMUNIS, Trin.
Frequent on wet ground. Huron, Castalia, Port Clinton, Harbors.

POA, L. Meadow-Grass.

P. ALSODES, Gray.
Florence; scarce.

P. *annual*, L. Low Spear-Grass.
Frequent.

P. *compressa*, L. Wire-Grass.
Abundant.

P. DEBILIS, Torr.
Furnace woods, Vermillion; rare.

P. PRATENSIS, L. June Grass. Kentucky Blue-Grass.
Abundant. One specimen has a panicle eleven inches long.

P. SEROTINA, Ehrhart.
Huron; rare.

P. SYLVESTRIS, Gray.
Parker's Creek, Florence; rare.

P. *trivialis*, L.
Shinrock; rare.

SETARIA, Beanv.

S. *glauca*, Beanv. Foxtail. Pigeon-Grass.
Abundant. The worst weed we have.

S. *italica*, Beanv. Italian Millet, Hungarian Grass.
Rarely escaped. Middle Bass, North Bass.

S. *verticillata*, Beanv.
Sandusky near Big Four dock, 1898.

S. *viridis*, Beanv. Green Foxtail.
Less abundant than S. *glauca*.

SPARTINA, Schreb. Marsh Grass.

S. SCHREBERI, J. F. Gmel. (S. CYNOSUROIDES Willd.)
Fresh-water Cord-Grass.
Frequent. Middle Bass.

SPOROBOLUS, R. Br. Rush-Grass.

S. ASPER, Kunth.
L. S. & M. S. Ry, east of Sandusky; rare.

S. CRYPTANDRUS, Gray.
Frequent on Cedar Point and several places on the Peninsula.

S. NEGLECTUS, Nash.
Sandusky, Castalia, Plaster Beds.

S. VAGINÆFLORUS, Vasey.
Common. Kelley's and Put-in-Bay the only Islands.

STIPA, L.

S. SPARTEA, Trin.* Porcupine Grass.
In sand; Cedar Point, Perkins, Bloomingville cemetery; rare.

TRIODIA, R. Br.

T. CUPREA, Jacq.* Tall Red-Top.
In sand near the road through the woods between Port Clinton and Catawba; rare.

TRIPLASIS, Beauv.

T. PURPUREA, Chapm. Sand-Grass.
Frequent on all sandy shores of Lake Erie; in places abundant. Kelley's Island.

ZIZANIA, L.

Z. AQUATICA, L. Indian Rice. Water Oats.
Abundant in shallow parts of Sandusky Bay, the Harbors, etc. Middle Bass.

CYPERACEÆ.

CAREX, L., Sedge.

C. ALBICANS, Willd.*
Put-in-Bay; rare.

C. ALBURSINA, Sheldon, (C. LAXIFLORA LATIFOLIA Boott.)
Frequent. Kelley's Island.

C. AQUATILIS, Wahl.
Huron, Cedar Point. Put-in-Bay; scarce.

C. ARCTATA, Boott.
Florence, Berlin, Oxford; rare.

C. AUREA, Nutt.*
One vigorous plant growing on a stump that stands in a stream near the Blue Hole, Castalia.

C. BICKNELLII, Britton (C. STRAMINEA CRAWEI, Boott.)
Berlin Heights; rare.

C. BROMOIDES, Schkuhr.
Florence, Berlin Heights, Milan; local.

C. CAREYANA, Torr.
Beecher's flats, Vermillion River; rare.

C. CEPHALOIDEA, Dewey.
Frequent.

C. CEPHALOPHORA, Muhl.
More frequent than the last. Bass Islands.

C. COMMUNIS, Bailey.
Florence, Margaretta Ridge; scarce.

C. COMMUNIS WHEELERI, Bailey.*
Vermillion River, Florence; rare.

C. CONJUNCTA, Boott.
Florence, Berlin, Perkins; scarce.

C. CRAWEI, Dewey.*
Castalia prairie, Marblehead; local.

C. CRINITA, Lam.
Frequent from the Huron River east, especially in Berlin.

C. DAVISII, Schwein & Torr.
Shinrock, Perkins, Port Clinton, Kelley's Island; infrequent.

C. DIGITALIS, Willd.
Common in Florence; frequent in Vermillion, Berlin and Milan.

C. DIGITALIS COPULATA, Bailey.
Florence, Berlin, Milan; frequent.

C. EBURNEA, Boott.*
Kelley's Island. Put-in-Bay; rare.

C. FILIFORMIS, L.
Frequent?

C. FŒNEA PERPLEXA, Bailey.*
Furnace woods, Vermillion; rare.

C. FUSCA, All.
Throughout Erie Co; infrequent.

C. GLAUCODEA, Tuckerm.
Vermillion, Berlin, Milan; infrequent.

C. GRACILLIMA, Schwein.
Frequent in Erie Co.

C. GRANULARIS, Muhl.
Frequent. Kelley's Island.

C. GRANULARIS HALEANA, Porter.* (C. HALEANA, Olney)
Florence, Castalia, Groton; infrequent.
The Groton specimens have very broad leaves.

C. GRAYII, Carey.
Huron, Milan and east; infrequent.

C. GRISEA, Wahl.
Rather frequent.

C. HITCHCOCKIANA, Dewey.
Florence; scarce.

C. HYSTERICINA, Muhl.
Common. Put-in-Bay and Middle Bass the only islands.

C. INTERIOR, Bailey.*
Castalia; rare.

C. INTUMESCENS, Rudge.
Berlin, Vermillion, Florence; infrequent.

C. JAMESII, Schwein.
Berlin; rare. Florence; infrequent.

C. LANUGINOSA, Michx. (C. FILIFORMIS LATIFOLIA, Boeckl.)
Frequent. Put-in-Bay.

C. LAXICULMIS, Schwein.
Florence, Vermillion, Milan; infrequent.

C. LAXIFLORA, Lam.
Frequent. Kelleys Island.

C. LAXIFLORA PATULIFOLIA, Carey.
Florence, Berlin, Huron; infrequent.

C. LAXIFLORA STRIATULA, Carey.
Common.

C. LAXIFLORA VARIANS, Bailey.
Common. Kelley's the only island.

C. LUPULINA, Muhl.
Common. The so-called variety *hedunculata* occurs in Florence.

C. LURIDA, Wahl.
Frequent. Hybrids of this and the last occur in Florence and Berlin.

C. MONILE, Tuckerm.
Vermillion, Berlin, Kimball; scarce.

C. MUHLENBERGII, Schkuhr.*
Cedar Point; frequent.

C. MUHLENBERGII ENERVIS, Boott.
Catawba; rare.

C. *muricata*, L.
Furnace woods, Vermillion; rare.

C. MUSKINGUMENSIS, Schwein.*
Catawba; rare.

C. OLIGOCARPA, Schkuhr.
Prout's, Shinrock, Vermillion, Florence: infrequent.

C. PALLESCENS.
Berlin Heights and Florence; rare.

C. PEDUNCULATA, Muhl.
Steep banks of Vermillion River, Florence; rare.

C. PENNSYLVANICA, Lam.
Abundant. Put-in-Bay the only island.

C. PLANTAGINEA, Lam.
Steep banks of Vermillion River and tributaries in southern Florence; infrequent.

C. PLATYPHYLLA, Carey.
High banks, Vermillion River, Florence; rare.

C. PRASINA, Wahl.
Infrequent.

C. PSEUDO-CYPERUS AMERICANA, Hochst. (C. COMOSA, Boott.)
Islands, Cedar Point, Castalia, South Florence; local.

C. PUBESCENS, Muhl.
Frequent, especially in Florence.

C. RICHARDSONII, R. Br.*
Castalia cemetery; rare.

C. RIPARIA, Curtis.
Infrequent.

C. ROSEA, Schkuhr.
Common. Middle Bass the only island.

C. ROSEA RADIATA, Dewey.
Florence; rare.

C. SARTWELLIANA, Olney.* (C. SARTWELLII, Dewey.)
Castalia; scarce. Huron, Cedar Point; rare.

C. SCABRATA, Schwein.
Springy banks of Vermillion River; rare.

C. SCOPARIA, Schkuhr.
Common. Not on the Islands.

C. SETACEA, Dewey.
Oxford; rare or else taken for *C. vulpinoidea*.

C. SHORTIANA, Dewey.
Perkins, Castalia, Berlin and common in Milan.

C. SICCATA, Dewey.*
Perrin's, Milan; Margaretta Ridge; rare.

C. SPARGANIOIDES, Muhl.
Frequent. Kelley's Island. Rattlesnake.

C. SQUARROSA, L.
Frequent.

C. STENOLEPIS, Torr.
Common, especially near Sandusky. Middle Bass the only island.

C. STERILIS, Schkuhr.
Castalia; rare.

C. STERILIS CEPHALANTHA, Bailey.
Tisdell's, Vermillion; rare.

C. STIPATA, Muhl.
Common.

C. STRAMINEA, Willd.
Infrequent.

C. STRAMINEA BREVIOR, Dewey.* (C. FESTUCACEA, Schkuhr.)
Marblehead, Johnson's Island, Kelley's, Green.

C. STRAMINEA MIRABILIS. Tuckerm.
Huron, Milan and east; rare.

C. STRICTA, Lam.
Scarce.

C. STRICTA DECORA, Bailey.* (C. HAYDENII, Dewey.)
Kimball; rare.

C. TENELLA, Schkuhr.
Vermillion River flat, Florence; one place.

C. TERETIUSCULA, Gooden.
Castalia; scarce.

C. TETANICA, Schkuhr.
Castalia prairie; frequent.

C. TETANICA MEADII, Bailey.*
Castalia prairie.

C. TETANICA WOODII, Bailey.
Huron and southern Florence in woods. Differs from the species in habitat and appearance.

C. TORTA, Boott.
nfrequent. One specimen considered a hybrid of this and *C. crinita.*

C. TRIBULOIDES, Wahl.
Frequent, especially the variety *turbata*. North Bass.

C. TRIBULOIDES CRISTATA, Bailey.
Common. North Bass the only island.

C. TRIBULOIDES REDUCTA, Bailey.*
Florence and Huron ; rare.

C. TRICEPS HIRSUTA, Bailey.
Frequent.

C. TRICHOCARPA, Muhl.
Huron River, Milan. The variety *imberbis* grows in Florence. Both scarce.

C. TRICHOCARPA ARISTATA, Bailey.*
Huron, Castalia ; infrequent.

C. TYPHINOIDES, Schwein.
East Berlin; local.

C. TUCKERMANNI, Boott.
Infrequent.

C. UTRICULATA, Boott.
Blair Creek, Florence; rare. The so-called variety *minor* at Tisdell's, Vermillion ; rare.

C. VARIA, Muhl.
Frequent.

C. VIRESCENS, Muhl.
Oxford, Huron and east; common.

C. VIRESCENS COSTATA, Dewey.
Berlin Heights and east; infrequent.

C. VIRIDULA, Michx.* (C. FLAVA VIRIDULA, Bailey.)
Castalia prairie; local.

C. VULPINOIDEA, Michx.
Common.

C. WILDENOWII, Schkuhr.
Florence; rare.

CLADIUM, P. Br. Twig-Rush.

C. TRIGLOMERATUM, Nees. (C. MARISCOIDES, Torr.)
Perkins, "Castalia," E. Claassen.

CYPERUS, L. Galingale.

C. DIANDRUS, Torr.
Frequent. Islands. The so-called variety *ca aneus* on Cedar Polnt.

C. ESCULENTUS, L.
Frequent in cultivated ground.

C. FILICULMIS, Vahl, (MARISCUS GLOMERATUS, Barto
Rather frequent in sand.

C. FLAVESCENS, L.*
Frankinberg's pasture, south-eastern Florence.

C. MICHAUXIANUS, Schult, (C. SPECIOSUS, Vahl.)
About Sandusky Bay; scarce.

C. REFRACTUS, Engelm.*
East branch, Vermillion River; one specimen.

C. SCHWEINITZII, Torr.
Cedar Point; common. Port Clinton.

C. STRIGOSUS, L.
Common and variable. Abundant in ma pastures. One specimen over three feet tall primary rays 8 inches long, secondary rays inches, spikelets nearly 1 inch.

DULICHIUM, Pers.

D. SPATHACEUM, Pers.
Perkins, Milan, Cedar Point; local.

ELEOCHARIS, R. Br. Spike-Rush.

E. ACICULARIS, R. Br.
Castalia and borders of marshes connected w Lake Erie; frequent. Bass Islands.

E. ACUMINATA, Nees.* (E. COMPRESSA, Sullivant.)
Sandusky, Cedar Point, Huron, Marbleh scarce.

E. ENGELMANNI, Steud.*
North of Tisdell's, Vermillion; rare.

E. INTERMEDIA, Schult.
Cedar Point, Johnson's Island, Marbleh Bass Islands; frequent.

E. OVATA, R. Br.
Frequent. Kelley's Island. North Bass.

E. PALUSTRIS, R. Br.
Frequent.

E. PALUSTRIS GLAUCESCENS, Gray.
Frequent. Put-in-Bay.

E. PALUSTRIS VIGENS, Bailey.*
Sandusky Bay; in water several feet deep.

E. TENUIS. Schult.
Infrequent.

ERIOPHORUM, L. Cotton-Grass.

E. POLYSTACHYON, L.
"Huron River" Henry Schoepfle.

FIMBRISTYLIS, Vahl.

F. AUTUMNALIS, R. & S.
A little bog near the Cedar Point light house.

F. CAPILLARIS, Gray.*
In sand, south Perkins and east of Milan ; local.

RYNCHOSPORA, Vahl. Beak-Rush.

R. CAPILLACEA, Torr.
Prairie along L. E. & W. Ry., west of Castalia ; local.

R. CYMOSA, Nutt.*
East of Milan ; local.

R. GLOMERATA, Vahl.*
East of Milan; local. Also ten miles west of Toledo.

SCIRPUS, L. Bulrush.

S. ATROVIRENS.
Common.

S. ERECTUS, Poir.* (S. DEBILIS, Pursh.)
Along shore of East Harbor west of Lakeside.

S. ERIOPHORUM, Michx. (ERIOPHORUM CYPERINUM, L.)
Frequent. The variety *laxum* occurs in Florence, Milan, and, probably, elsewhere.

S. LACUSTRIS, L. Great Bulrush.
Common. Extensively used in the vineyards for tying up the vines.

S. LINEATUS, Michx. (ERIOPHORUM LINEATUM, Benth & Hook.)
Frequent. Kelley's Island. North Bass.

S. MARITIMUS, L. (S. FLUVIATILIS, Gray.) River Club-Rush.
Common in the marshes east of Sandusky and in the East Harbor; elsewhere infrequent. Put-in-Bay.

S. POLYPHYLLUS, Vahl.
Frequent. Middle Bass.

S. PUNGENS, Vahl.
Common, especially about Sandusky Bay and Lake Erie.

S. SYLVATICUS, L.*
"Pond near U. S. Fish Hatchery, Put-in-Bay." A. J. Pieters.

S. TORREYI, Olney.*
North side of East Harbor; rare.

SCLERIA, Berg. Nut-Rush.

S. PAUCIFLORA, Muhl.*
East of Milan; local. Also ten miles west of Toledo.

S. TRIGLOMERATA, Michx.*
East of Milan; local. Also ten miles west of Toledo.

ARACEÆ.

ACORUS, L. Sweet Flag.

A. CALAMUS, L.
Frequent. Abundant near Port Clinton. Put-in-Bay. "Kelley's Island."

ARISÆMA, Mart.

. DRACONTIUM, Schott. Green Dragon, Dragon-root.
Scarce.

. TRIPHYLLUM, Schott. Indian Turnip.
Common.

SYMPLOCARPUS, Salisb. Skunk Cabbage.

. FOETIDUS, Nutt.
Infrequent.

LEMNACEÆ.

LEMNA, L. Duck-weed, Duck's-meat.

L. MINOR, L.
Common at Castalia and on still water connected with Lake Erie. Islands.

L. POLYRRHIZA, L. (SPIRODELA POLYRRHIZA, Schleid.)
Common on still water connected with the Lake. Florence.

L. TRISULCA, L.
Castalia and still waters connected with the Lake; infrequent- Put-in-Bay.

WOLFFIA, Workel.

W. COLUMBIANA, Karsten.
Mouth of Old Woman Creek, Pipe Creek, Put-in-Bay; local.

COMMELINACEÆ.

TRADESCANTIA, L. Spiderwort.

T. VIRGINIANA, L.
Frequent, especially on Cedar Point.

T. VIRGINIANA OCCIDENTALIS, Britton.
B. & O. Ry. seven miles south of depot; rare.

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Frequent, especially on Cedar Point.

T. VIRGINIANA OCCIDENTALIS, Britton.
B. & O. Ry. seven miles south of depot; rare.

PONTEDERIACEÆ.

HETERANTHERA, Ruiz & Pav. Mud-Plantain.

H. GRAMINEA, Vahl.
Common in still water connected with Lake Erie.

PONTEDERIA, L. Pickerel-weed.

P. CORDATA, L.
Frequent in shallow water connected with Lake Erie.

JUNCACEÆ.

JUNCUS, L. Rush. Bog-Rush.

J. ACUMINATUS, Michx.
Florence; rare.

J. ALPINUS INSIGNIS, Fries.
Castalia, Oxford, shores of Lake Erie; frequent. Kelley's Island.

J. BALTICUS LITTORALIS, Engelm.
Castalia, Cedar Point, Marblehead sand spit; locally abundant.

J. BUFONIUS, L.
Sandusky near B. & O. and L. S. & M. S. Ry's; rare.

J. CANADENSIS.
Shinrock and Sandusky where the so-called variety *longicaudatus* grows.

J, CANADENSIS BRACHYCEPHALUS, Engelm.
Castalia, Willow Point, Sandy Beach.

J. EFFUSUS, L. Common or Soft Rush.
Frequent. North Bass.

J. MARGINATUS, Rostk.
Berlin, Vermillion, east of Milan ; infrequent.

J. NODOSUS, L.
Frequent.

J. NODOSUS MEGACEPHALUS, Torr.
Frequent. Islands.

J. SCIRPOIDES, Lam.*
Oxford, southern Perkins, Vermillion; infrequent.

J. TENVIS, Willd.
Common.

LUZULA, D C. Wood-Rush.

L. CAMPESTRIS, D C.
Frequent, especially in Milan.

L. VERNALIS, D C.
Vermillion River, Chapelle Creek; scarce.

LILIACEÆ.

ALETRIS, L.

A. FARINOSA, L.*
Perrin's, Milan and Joseph Smith's, Perkins; rare

ALLIUM, L.

A. CANADENSE, L. Wild Garlic.
Infrequent. Kelley's Island.

A. CERNUUM, Roth. Wild Onion.
Common on the Islands, Peninsula, and at Castalia.

A. TRICOCCUM, Ait. Wild Leek.
Islands, Peninsula, Florence; infrequent.

ASPARAGUS, L.

A. *officinalis*, L. Garden Asparagus.
Escaped in many places. Islands.

CAMASSIA, Lindl.

C. FRASERI, Torr. Wild Hyacinth.
Infrequent, but occurs on eight islands and in eight townships.

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Frequent. The variety *laxum* occurs in Florence, Milan, and, probably, elsewhere.

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North side of East Harbor; rare.

SCLERIA, Berg. Nut-Rush.

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East of Milan; local. Also ten miles west of Toledo.

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Infrequent.

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Castalia and still waters connected with the Lake; infrequent- Put-in-Bay.

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Castalia, Cedar Point, Marblehead sand spit; locally abundant.

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Shinrock and Sandusky where the so-called variety *longicaudatus* grows.

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Frequent. North Bass.

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Frequent. Islands.

J. SCIRPOIDES, Lam.*
Oxford, southern Perkins, Vermillion; infrequent.

J. TENVIS, Willd.
Common.

LUZULA, D C. Wood-Rush.

L. CAMPESTRIS, D C.
Frequent, especially in Milan.

L. VERNALIS, D C.
Vermillion River, Chapelle Creek; scarce.

LILIACEÆ.

ALETRIS, L.

A. FARINOSA, L.*
Perrin's, Milan and Joseph Smith's, Perkins; rare

ALLIUM, L.

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Infrequent. Kelley's Island.

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Escaped in many places. Islands.

CAMASSIA, Lindl.

C. FRASERI, Torr. Wild Hyacinth.
Infrequent, but occurs on eight islands and in eight townships.

CHAMAELIRIUM. Willd.

C. CAROLINIANUM, Willd. Blazing-Star.
Southern Perkins, Margaretta Ridge, east o
Milan, Berlin Heights; rare.

DISPORUM, Salisb.

D. LANUGINOSUM, Nichols.
Florence, Berlin; scarce.

ERYTHRONIUM, L.

E. ALBIDUM, Nutt. White Dog's-tooth Violet.
A weed in vineyards west of Sandusky
Common on Huron River bottoms, Infrequen
or rare in other parts of the county.
Johnson's Island, Kelley's, Rattlesnake, Por
Clinton.

E. AMERICANUM, Ker. Yellow Adder's-tongue.
Common.

HEMEROCALLIS, L.

H. *fulva*, L.
Roadsides; infrequent. North Bass.

LILIUM, L.

L. CANADENSE, L. Wild Yellow Lily.
Infrequent. Kelley's, Island.

L. PHILADELPHICUM, L. Wild Orangered Lily. Woo
Lily.
Scarce.

L. SUPERBUM, L. Turk's-cap Lily.
Milan, Florence, Vermillion; rare. Mr. Haise
Florence found "several years ago a lily wi
forty or fifty flowers."

MAIANTHEMUM, Wigg.

M. CONVALLARIA, Wigg. (M. CANADENSE, Desf.) Fals
Lily-of-the-valley.
Cedar Point and high banks of Old Wom
Creek, Chapelle Creek and Vermillion Rive
infrequent.

MEDEOLA, L. Indian Cucumber-root.

M. VIRGINICA, L.
Florence, Berlin, Milan, Perkins; scarce.

OAKESIA, Watson.

O. SESSILIFOLIA, Watson.
Florence; rare.

ORNITHOGALUM, L. Star-of-Bethlehem.

O. *umbellatum* L.
Perkins, Sandusky, Put-in-Bay; rare.

POLYGONATUM, Adans.

P. BIFLORUM, Ell. Smaller Solomon's Seal.
Common.

P. GIGANTEUM, Dietrich. Great Solomon's Seal.
Common.

SMILACINA, Desf. False Solomon's Seal.

S. RACEMOSA, Desf. False Spikenard.
Common.

S. STELLATA, Desf.
Common; less so on the mainland than the preceding.

SMILAX, L. Greenbrier.

S. ECIRRHATA, Watson.
Perkins, Groton, Catawba, Kelley's Island; scarce.

S. HERBACEA, L. Carrion-Flower.
Common.

S. HISPIDA, Muhl.
Frequent. Islands.

S. ROTUNDIFOLIA, L. Horse-brier.
Infrequent. Put-in-Bay.
The "variety" *crenulata* S. & H. found at Chapelle Creek.

TRILLIUM, L. Wake Robin.

T. ERECTUM, L.
Common.

T. GRANDIFLORUM, Salisb.
Common.

T. SESSILE, L.
Vermillion River flats; frequent.

UVULARIA, L. Bellwort.

U. GRANDIFLORA.
Infrequent. Islands.

ZYGADENUS, Michx.

Z. ELEGANS, Pursh.*
Marblehead; rare.

AMARYLLIDACEÆ.

HYPOXIS, L. Star-Grass.

H. ERECTA, L.
Infrequent.

DIOSCOREACEÆ.

DIOSCOREA, L. Yam.

D. VILLOSA, L. Wild Yam-root.
Frequent. Kelley's Island, Put-in-Bay.

IRIDACEÆ.

IRIS, L. Flower-de-Luce.

[I. CRISTATA, Ait, Crested Dwarf Iris.
Our specimens of this rare plant were collected along the Vermillion River in what was said to be Erie County, but the spot proves to be a few yards south of the line. Eli Beecher, who owns the adjacent flats in Erie County, says he has seen it there.]

I. VERSICOLOR, L. Larger Blue Flag.
Frequent. Islands.

SISYRINCHIUM, L. Blue-eyed Grass.

S. ANGUSTIFOLIUM, Mill.
Infrequent.

S. GRAMINOIDES, Bicknell.
Infrequent.

ORCHIDACEÆ.

APLECTRUM, Torr. Putty-Root. Adam-and-Eve.

A. HYEMALE, Torr.
Rare. Puckrin's woods, Perkins. "Smith's, Perkins," Ross Ransom. "Cedar Point," Claassen and Krebs. "Marblehead," Gertrude Johnson. "Vermillion," Otto Todd. "Formerly considerable near the quarry on west branch of Vermillion River," Eli Beecher.

CALOPOGON, R. Br.

C. PULCHELLUS, R. Br.
South-west of Castalia; rare. Seen only in 1895.

CORALLORHIZA, Haller. Coral-root.

C. MULTIFLORA, Nutt.
Florence, Huron, Catawba; rare.

C. ODONTORHIZA, Nutt.
Blair Creek, Florence; Graham's woods, Huron; Smith's woods, Perkins; rare.

CYPRIPEDIUM, L. Lady's Slipper. Moccason-flower.

C, CANDIDUM, Muhl.* Small White Lady's Slipper.
Along a railroad near Castalia; locally common.

C. PUBESCENS, Willd. Larger yellow Lady's Slipper.
In seven townships, but rare.

C. SPECTABILE, Salisb. Showy Lady's Slipper.
One spot on high, wet, shale bank of east branch, Vermillion River. An orchid found by Job Fish "about 1859, the most beautiful wild flower" he "ever found" was probably of this species.

GOODYERA, R. Br. Rattlesnake-Plantain.

G. PUBESCENS, R Br.
Florence, Berlin, Milan, Oxford, Perkins; scarce.

HABENARIA, Willd. Rein-Orchis.

H. BRACTEATA, R. Br.
In five townships; rare.

H. HERBIOLA, R. Br. (H. VIRESCENS, Spreng.)
In five townships; rare.

H. HOOKERIANA, Torr.
"Margaretta Ridge," Henry Schoepfle; one plant.

H. LACERA R. Br. Ragged Fringed-Orchis.
Perkins, Milan, Vermillion; rare.

H. PSYCODES, Gray. Purple Fringed-Orchis.
Florence, Milan, "Cedar Point," Leslie Stair: rare.

H. TRIDENTATA, Hook.
East of Milan; one plant.

LIPARIS, Richard. Twayblade.

L. LŒSELII, Richard.
Bog near Cedar Point Light House,

ORCHIS, L.

O. SPECTABILIS, L. Showy Orchis.
Rather frequent in Florence, infrequent in four townships.

POGONIA, Juss.

P. PENDULA, Lindl.
"Florence," Josephine Fish, also Otto Todd; East Berlin; "Perkins," Ransom; local.

SPIRANTHES, Richard. Ladies' Tresses.

S. CERNUA, Richard.
Local. This and *Orchis spectabilis* are less rare than our other orchids.

S. GRACILIS, Beck.
"Bloomingville," W. A, Kellerman. Perkins; rare.

DICOTYLEDONES.

SAURURACEÆ.

SAURURUS, L. Lizard's-tail.

S. CERNUUS, L.
Frequent in eastern part of the county; infrequent in Huron, Milan and Perkins.

JUGLANDACEÆ.

CARYA, Nutt. Hickory.

C. ALBA, Nutt. Shell-bark or Shag-bark Hickory.
Abundant. Hickory is used in Sandusky by two wheel works and two whip-stalk factories; also by the Sandusky Tool Company for chisel handles, for tin-smith's mallets, and for ladder-rounds that are sent to Northern Michigan for use in the copper mines.

C. AMARA, Nutt. Bitter-nut or Swamp Hickory.
Frequent. One in the German Settlement has a circumference of 9 feet, 8 inches.

C. MICROCARPA, Nutt.
Frequent, at least in Perkins.

C. SULCATA, Nutt. Big Shell-bark. King-nut.
Frequent.

C. TOMENTOSA, Nutt. Mocker-nut. White-heart Hickory.
Frequent. Put-in-Bay.

C. PORCINA, Nutt. Pig-nut or Broom Hickory.
Frequent. Islands.

JUGLANS, L.

J. CINEREA, L. Butternut. White Walnut.
Infrequent.

J. NIGRA, L. Black Walnut.
Frequent. Said to have grown formerly on Kelley's Island, and Middle Bass. The number and size of the walnut stumps along the border of the Huron marsh east of Sandusky and of the prostrate trunks in the marsh is remarkable. See page 14.

SALICACEÆ.

POPULUS, L.

P. *alba*, L. White Poplar. Abele.
Frequent in the vicinity of planted trees. Kelley's Island. Put-in-Bay.

P. GRANDIDENTATA, Michx. Large-toothed Aspen.
Rather frequent. Put-in-Bay. Plentiful along the lake shore drive east of Huron.

P. HETEROPHYLLA, L. Downy Poplar.
Florence, Huron; rare.

P. MONILIFERA, Ait. Cotton-wood. Necklace Poplar.
Common.

P. TREMULOIDES, Michx. American Aspen.
Frequent, especially on the Islands.

SALIX, L. Willow. Osier.

S. *alba cærulea*, Koch. Blue Willow.
Cedar Point and Sandusky near the Bay; rare.

S. *alba vitellina*, Koch. Golden Osier.
Frequent. Islands.

S. AMYGDALOIDES, Anders.
Frequent.

S. CANDIDA, Willd.* Sage Willow. Hoary Willow.
Castalia prairie; rare.

S. CORDATA, Muhl. Heart-leaved Willow.
Common, but not noticed on Kelley's Island.

S. CORDATA ANGUSTATA, Anders.
Infrequent. Put-in-Bay.

S. DISCOLOR, Muhl. Glaucous Willow.
Frequent, as is also the "variety" *eriocephala*.

S. GLAUCOPHYLLA, Bebb.
Cedar Point, Castalia; infrequent.

S. HUMILIS, Marsh. Prairie Willow.
Oxford; scarce.

S. LONGIFOLIA, Muhl.
Common, especially along the lake.

S. LUCIDA, Muhl.
Florence, Marblehead, Put-in-Bay; infrequent.

S. NIGRA, Marsh. Black Willow.
Frequent. Islands.

S. NIGRA FALCATA, Torr.
Frequent.

S. PETIOLARIS, Smith.
House's swamp, southern Perkins.

S. *purpurea*, L. Purple Willow.
Infrequent. Kelley's Island. Put-in-Bay.

S. ROSTRATA, Richardson.
Infrequent. Islands.

S. SERICEA, Marsh. Silky Willow.
House's swamp, Perkins. Milan?

S. *fragilis* × *alba*.
Castalia, etc.

BETULACEÆ.

CARPINUS, L. Iron-wood.

C. AMERICANA, Michx. American Hornbeam. Blue or Water Beech.
Frequent. "Formerly many on Kelley's Island." Lester Carpenter.

CORYLUS, L.

C. AMERICANA, Walt. Hazel-nut.
Common. Not on the Islands.

OSTRYA, L. Iron-wood.

O. VIRGINICA, Willd. American Hop-Hornbeam. Lever-wood.
Common, especially on rocky shores of the Islands.

FAGACEÆ.

CASTANEA, L.

C. SATIVA AMERICANA, Watson. Chestnut.
Common in Erie County in sandy soil.
Chestnut fence posts sometimes put forth leafy shoots.

FAGUS, L.

F. FERRUGINEA, Ait. American Beech.
Not on Islands or Peninsula, nor within five miles of Sandusky. A few in Kromer's woods and farther south along Pipe Creek. Infrequent along Huron River in Milan, frequent in Berlin, common in Vermillion, abundant in Florence. "Two trees on Put-in-Bay thirty years ago," Vroman. "Formerly a few on Middle Bass." Wood found in the submerged forest, Huron Marsh. Most Sandusky children do not know beech nuts. Wood used by Sandusky Tool Company for planes.

QUERCUS, L. Oak.

Q. ALBA, L. White Oak.
Common.

Q. BICOLOR, Willd. Willd. Swamp White Oak.
Frequent. Kelley's Island.

Q. COCCINEA, Wang. Scarlet Oak.
East of Milan; frequent. Marblehead, Port Clinton, Catawba and probably elsewhere.

Q. IMBRICARIA, Michx. Laurel or Shingle Oak.
Common in middle and western parts of Erie County. Abundant in Oxford and on Cedar Point.

Q. MACROCARPA, Michx. Bur Oak, Over-cup or Mossy-cup Oak.
Frequent. Islands. Under the large Bur Oak at the corner of Wayne and Jefferson Sts., the Indians used to hold their councils. It is said to have grown very little since the early settlers came to Sandusky.

Q. MUHLENBERGII, Engelm. Yellow Oak. Chestnut Oak.
Common on the Peninsula and Islands. Less frequent in Erie County.

Q. PALUSTRIS, Du Roi. Swamp Spanish or Pin Oak.
Common. Not noticed on the Islands.

Q. PRINUS, L. Rock Chestnut Oak.
Sandusky. Marblehead, Islands and elsewhere? The oak in Judge Mackey's yard on Columbus Ave. south of the fair grounds is of this species.

Q. RUBRA, L. Red Oak.
Common.

Q. VELUTINA, Lam. (Q. TINCTORIA,) Bartram. Black Oak. Quercitron.
Common. Kelley's and Put-in-Bay the only islands. On Cedar Point, where this species abounds, is a tree which I should call Q. *marylandica*, Muench., were I not advised differently, and other trees of the same sort or else hybrids between it and Q. *velutina*. None of these were noticed until September, 1898.

C. TOMENTOSA, Nutt. Mocker-nut. White-heart Hickory.
Frequent. Put-in-Bay.

C. PORCINA, Nutt. Pig-nut or Broom Hickory.
Frequent. Islands.

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Infrequent.

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P. MONILIFERA, Ait. Cotton-wood. Necklace Poplar.
Common.

P. TREMULOIDES, Michx. American Aspen.
Frequent, especially on the Islands.

SALIX, L. Willow. Osier.

S. *alba cærulea*, Koch. Blue Willow.
Cedar Point and Sandusky near the Bay; rare.

S. *alba vitellina*, Koch. Golden Osier.
Frequent. Islands.

S. AMYGDALOIDES, Anders.
Frequent.

S. CANDIDA, Willd.* Sage Willow. Hoary Willow.
Castalia prairie; rare.

S. CORDATA, Muhl. Heart-leaved Willow.
Common, but not noticed on Kelley's Island.

S. CORDATA ANGUSTATA, Anders.
Infrequent. Put-in-Bay.

S. DISCOLOR, Muhl. Glaucous Willow.
Frequent, as is also the "variety" *eriocephala*.

S. GLAUCOPHYLLA, Bebb.
Cedar Point, Castalia; infrequent.

S. HUMILIS, Marsh. Prairie Willow.
Oxford; scarce.

S. LONGIFOLIA, Muhl.
Common, especially along the lake.

S. LUCIDA, Muhl.
Florence, Marblehead, Put-in-Bay; infrequent.

S. NIGRA, Marsh. Black Willow.
Frequent. Islands.

S. NIGRA FALCATA, Torr.
Frequent.

S. PETIOLARIS, Smith.
House's swamp, southern Perkins.

S. *purpurea*, L. Purple Willow.
Infrequent. Kelley's Island. Put-in-Bay.

S. ROSTRATA, Richardson.
Infrequent. Islands.

S. SERICEA, Marsh. Silky Willow.
House's swamp, Perkins. Milan?

S. *fragilis* × *alba*.
Castalia, etc.

BETULACEÆ.

CARPINUS, L. Iron-wood.

C. AMERICANA, Michx. American Hornbeam. Blue or Water Beech.
Frequent. "Formerly many on Kelley's Island." Lester Carpenter.

CORYLUS, L.

C. AMERICANA, Walt. Hazel-nut.
Common. Not on the Islands.

OSTRYA, L. Iron-wood.

O. VIRGINICA, Willd. American Hop-Hornbeam. Lever-wood.
Common, especially on rocky shores of the Islands.

FAGACEÆ.

CASTANEA, L.

C. SATIVA AMERICANA, Watson. Chestnut.
Common in Erie County in sandy soil.
Chestnut fence posts sometimes put forth leafy shoots.

FAGUS, L.

F. FERRUGINEA, Ait. American Beech.
Not on Islands or Peninsula, nor within five miles of Sandusky. A few in Kromer's woods and farther south along Pipe Creek. Infrequent along Huron River in Milan, frequent in Berlin, common in Vermillion, abundant in Florence. "Two trees on Put-in-Bay thirty years ago," Vroman. "Formerly a few on Middle Bass." Wood found in the submerged forest, Huron Marsh. Most Sandusky children do not know beech nuts. Wood used by Sandusky Tool Company for planes.

QUERCUS, L. Oak.

Q. ALBA, L. White Oak.
Common.

Q. BICOLOR, Willd. Willd. Swamp White Oak.
Frequent. Kelley's Island.

Q. COCCINEA, Wang. Scarlet Oak.
East of Milan; frequent. Marblehead, Port Clinton, Catawba and probably elsewhere.

Q. IMBRICARIA, Michx. Laurel or Shingle Oak.
Common in middle and western parts of Erie County. Abundant in Oxford and on Cedar Point.

Q. MACROCARPA, Michx. Bur Oak, Over-cup or Mossy-cup Oak.
Frequent. Islands. Under the large Bur Oak at the corner of Wayne and Jefferson Sts., the Indians used to hold their councils. It is said to have grown very little since the early settlers came to Sandusky.

Q. MUHLENBERGII, Engelm. Yellow Oak. Chestnut Oak.
Common on the Peninsula and Islands. Less frequent in Erie County.

Q. PALUSTRIS, Du Roi. Swamp Spanish or Pin Oak.
Common. Not noticed on the Islands.

Q. PRINUS, L. Rock Chestnut Oak.
Sandusky. Marblehead, Islands and elsewhere? The oak in Judge Mackey's yard on Columbus Ave. south of the fair grounds is of this species.

Q. RUBRA, L. Red Oak.
Common.

Q. VELUTINA, Lam. (Q. TINCTORIA,) Bartram. Black Oak. Quercitron.
Common. Kelley's and Put-in-Bay the only islands. On Cedar Point, where this species abounds, is a tree which I should call Q. *marylandica*, Muench., were I not advised differently, and other trees of the same sort or else hybrids between it and Q. *velutina*. None of these were noticed until September, 1898.

ULMACEÆ.

CELTIS, L.

C. OCCIDENTALIS, L. Hackberry. Sugar-berry.
Frequent. Common on the Islands and Cedar Point.

ULMUS, L.

U. AMERICANA, L. American or White Elm.
Common. Wood used for the handles and bands of baskets and for lime barrels.

U. FULVA, Michx. Slippery or Red Elm.
Frequent. All the Islands.

MORACEÆ.

CANNABIS, L.

C. *sativa*, L. Hemp.
Roadside, Margaretta or Groton; very rare.

HUMULUS, L.

H. LUPULUS, L. Hop.
Castalia, Milan; infrequent.

MACLURA, Nutt.

M. AURANTIACA, Nutt. Osage Orange.
Found only near where it has been planted; scarcely naturalized. The row of trees on the Ransom place, Castalia road, probably surpasses any farther north in America.

MORUS, L.

M. *alba*, L.* White Mulberry.
Rare in woods, where the seeds have probably been dropped by birds.

M. RUBRA, L. Red Mulberry.
Throughout, but infrequent. "Formerly common at Port Clinton." Islands.

URTICACEÆ.

BŒHMERIA, Jacq.

B. CYLINDRICA, Sw. False Nettle.
Common.

LAPORTEA, Gaudichaud.

L. CANADENSIS, Gaudichaud. Wood-Nettle.
Common.

PARIETARIA, L.

P. PENNSYLVANICA, Muhl. Pellitory.
Abundant.

PILEA, Lindl.

P. PUMILA, Gray. Richweed. Clearweed.
Common. Kelley's the only island.

URTICA, L. Nettle.

U. GRACILIS, Ait.
Common.

SANTALACEÆ.

COMANDRA, Nutt. Bastard Toad-flax.

C. UMBELLATA, Nutt.
Frequent.

ARISTOLOCHIACEÆ.

ARIRTOLOCHIA, L.

A. SERPENTARIA, L. Virginia Snakeroot.
Florence, Berlin, Perkins, Margaretta; scarce.

ASARUM, L. Wild Ginger.

A. ACUMINATUM, Bicknell.
Florence and probably elsewhere.

A. REFLEXUM, Bicknell.
Huron River, Milan, and probably elsewhere. The variety *ambiguum* also occurs.

POLYGONACEÆ.

FAGOPYRUM, Gaertn.

F. ESCULENTUM, Moench. Buckwheat.
Infrequent, except in fields where it has sometime been sown.

POLYGONUM, L. Knotweed.

P. ACRE, H. B. K. Water Smartweed.
Common.

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Marblehead; rare.

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A few plants near L. S. & M. S. freight house. Doubtless introduced.

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Cedar Point, Lockwood's; infrequent.

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Sandusky; frequent. Kelley's Island, and probably many other places near Lake Erie. We failed to distinguish it, till recently, from P. *aviculare*.

P. MUHLENBERGII, Watson.
Frequent. Islands.

P, *orientale*, L.
Barely naturalized in two or three places.

P. PENNSYLVANICUM, L.
Abundant. Kelley's and Middle Bass the only islands where it has been noticed.

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Hill's woods, southern Perkins; one plant.

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Margaretta, Cedar Point and probably elsewhere. See P. *dumetorum*.

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Marblehead; frequent. Margaretta, between quarry and Castalia road. Only in thin soil overlying the lime stone.

P. VIRGINIANUM, L.
Common. Not on the Islands.

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Abundant. Put-in-Bay; rare. "Kelley's Island." Not on other islands.

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Common. Not on the Islands.

RUMEX, L.

R. *acetosella*, L. Field or Sheep Sorrel.
Abundant. Put-in-Bay; rare. "Kelley's Island." Not on other islands.

R. ALTISSIMUS, Wood. Pale Dock.
Sandusky by Big Four track, Put-in-Bay; rare; also Oak Harbor, Ottawa County.

R. BRITANNICA, L. Great Water-Dock.
Marshes connected with Sandusky Bay; frequent.

R. *crispus*, L. Curled Dock.
Abundant.

R. *obtusifolius*, L. Bitter Dock.
Common.

R. VERTICILLATUS.
Common in marshes.

CHENOPODIACEÆ.

ATRIPLEX, L. Orache.

A. ARGENTEA, Nutt.
Near Big Four R. R., Sandusky and Castalia; rare.

A. HASTATA, L.
Common near Lake and Bay. In many places in Sandusky the most common weed.

A. LITTORALIS, L.*
Sandusky; frequent. Huron.

CHENOPODIUM, L. Pigweed.

C. *album*, L. Lamb's Quarters. Pigweed.
Common.

C. *album viride*, Moq.
Common.

C. *ambrosioides*, L. Mexican Tea.
L. S. & M. S. R. R. yards, Sandusky; rare.

C. BOSCIANUM, Moq.
Cedar Point, Perkins, Kelley's Island, and, doubtless, elsewhere.

C. *botrys*, L. Jerusalem Oak. Feather Geranium.
Western part of Erie Co., mostly along railways (C. S. & H. and L. E. & W). Marblehead. Kelley's Island. Infrequent except on Marblehead.

C. *glaucum*, L. Oak-leaved Goosefoot.
Castalia prairie and along L. E. & W. Ry. at Castalia and Sandusky; rare.

C. HYBRIDUM, L. Maple-leaved Goosefoot.
Islands, Peninsula, Cedar Point, Perkins, Margaretta; frequent.

C. LEPTOPHYLLUM, Nutt.*
Cedar Point and probably elsewhere; infrequent.

C. *murale*, L.
Sandusky; infrequent.

C. *urbicum*, L.
Rather frequent on the Peninsula, and in the western third of Erie Co. Kelley's Island.

AMARANTACEÆ.

ACNIDA, L.

A. TUBERCULATA, Moq.
Wet ground near Lake and Bay and at Castalia; infrequent. Kelley's Island. Middle Bass

AMARANTUS, L. Amaranth.

A. ALBUS, L. Tumble Weed.
Common.

A. BLITOIDES, Watson.
Common.

A. *chlorostachys*, Willd.
Common.

A. *hypochondriacus*, L.
Sandusky, Perkins; scarce.

A. *paniculatus*, L.
Roadsides, Sandusky and Islands; infrequent.
A. *retroflexus*, L.
Common.

PHYTOLACCACEÆ.

PHYTOLACCA, L.

P. DECANDRA, L. Poke. Scoke. Pigeon-berry. Garget. Common.

NYCTAGINACEÆ.

OXYBAPHUS, Vahl.

O. NYCTAGINEUS, Sweet.
L. S. & M. S. Ry. in eastern Sandusky.

AIZOACEÆ.

MOLLUGO, L.

M. VERTICILLATA, L. Carpet-weed.
Sandusky, southern Perkins, Milan; local.

PORTULACACEÆ.

CLAYTONIA, L.

C. VIRGINICA, L. Spring Beauty.
Abundant.

PORTULACA, L.

P. *oleracea*, L. Purslane.
Abundant.

CARYOPHYLLACEÆ.

ANYCHIA, Michx. Forked Chickweed.

A. CAPILLACEA, DC.
Infrequent. Put-in-Bay.

A. DICHOTOMA, Michx.
Marblehead, Catawba, infrequent. Plentiful in places on the shale in Oxford and Perkins.

ARENARIA, L. Sandwort.

A. LATERIFLORA, L.
Lake woods, Port Clinton and Big woods, Perkins; rare.

A. *serpyllifolia*, L. Thyme-leaved Sandwort.
Islands, Peninsula, Margaretta, western Perkins; frequent.

A. STRICTA, Michx.
Islands, Peninsula, Margaretta, western Perkins, Cedar Point; locally common.

CERASTIUM, L. Mouse-ear Chickweed.

C. NUTANS, Raf.
Frequent. Islands.

C. OBLONGIFOLIUM, Torrey.*
More frequent than the last on Islands and Peninsula and in the western half of Erie Co.

C. *vulgatum*, L.
Common.

LYCHNIS, L.

L. *dioica*, L. Red Lychnis.
Avery; probably adventive.

L. *githago*, Scop. Corn Cockle.
Common. Kelley's the only Island.

L. *vespertina*, Sibth.
Franz Otto's, Perkins.

SAPONARIA, L.

S. *officinalis*, L. Soapwort. Bouncing Bet.
Frequent. Islands.

SILENE, L.

S. ANTIRRHINA, L. Sleepy Catchfly.
Frequent. Kelley's Island.

S. *cońica*, L.* Corn Catchfly.
"Sandy field west of B. & O. R. R., southern Perkins." Ross Ransom. The first recorded appearance of this plant in the United States was at Clyde, Sandusky County, where it was introduced in Crimson Clover seed, 1896.

S. *cucubalus*, Wibel.* Bladder Campion.
Well established and increasing in a field of James Hamilton, Kelley's Island.

S. *dichotoma*, Ehrh. Forked Catchfly.
Northeast of Port Clinton; probably adventive.

S. *noctiflora*, L. Night-flowering Catchfly.
Sandusky; scarce.

S. VIRGINICA, L. Fire Pink.
Put-in-Bay; frequent. Kelley's Island. Catawba, Hartshorn's, Johnson's Island. "Cedar Point," Alden Knight.

STELLARIA, L.

S. LONGIFOLIA, Muhl. Long-leaved Stitchwort.
Frequent.

S. *media*, Cyrill. Common Chickweed.
Abundant.

NYMPHÆACEÆ.

BRASENIA, Schreber.

B. PELTATA, Pursh. Water-shield.
Cedar Point; one plant.

NELUMBIUM, Adans. Sacred Bean.

N. LUTEUM, Willd. American Nelumbo or Lotus. Water Chinkapin or Wankapin.

In still, deep, water at several places about Sandusky Bay, in the East and West Harbors, at Port Clinton where a large amount of it grows in the Portage River, and west to Monroe, Michigan, but believed to grow nowhere along the American shore of Lake Erie east of the mouth of the Old Woman Creek. A hundred acres of it at the head of Sandusky Bay and along the river, more, probably, than the whole quantity in the United States farther east. The lotus has the largest flowers and largest leaves of any plant in the Sandusky flora. Petioles sometimes 9 feet long; "blades 26 inches broad."

NUPHAR, Smith. Spatter-Dock.

N. ADVENA, Ait. Yellow Pond-Lily.

Sandusky Bay, Middle Bass, Blair Creek; freqnent.

NYMPHAEA, Tourn. Water-Lily.

N. TUBEROSA, Paine.

Common in still waters connected with the Bay and Lake.

CERATOPHYLLACEÆ.

CERATOPHYLLUM, L. Hornwort.

C. DEMERSUM, L.

Sandusky Bay, East Harbor, Port Clinton, Put-in-Bay; common.

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S. *media*, Cyrill. Common Chickweed.
Abundant.

NYMPHÆACEÆ.

BRASENIA, Schreber.

B. PELTATA, Pursh. Water-shield.
Cedar Point; one plant.

NELUMBIUM, Adans. Sacred Bean.

N. LUTEUM, Willd. American Nelumbo or Lotus. Water Chinkapin or Wankapin.

In still, deep, water at several places about Sandusky Bay, in the East and West Harbors, at Port Clinton where a large amount of it grows in the Portage River, and west to Monroe, Michigan, but believed to grow nowhere along the American shore of Lake Erie east of the mouth of the Old Woman Creek. A hundred acres of it at the head of Sandusky Bay and along the river, more, probably, than the whole quantity in the United States farther east. The lotus has the largest flowers and largest leaves of any plant in the Sandusky flora. Petioles sometimes 9 feet long; "blades 26 inches broad."

NUPHAR, Smith. Spatter-Dock.

N. ADVENA, Ait. Yellow Pond-Lily.

Sandusky Bay, Middle Bass, Blair Creek; freqnent.

NYMPHAEA, Tourn. Water-Lily.

N. TUBEROSA, Paine.

Common in still waters connected with the Bay and Lake.

CERATOPHYLLACEÆ.

CERATOPHYLLUM, L. Hornwort.

C. DEMERSUM, L.

Sandusky Bay, East Harbor, Port Clinton, Put-in-Bay; common.

MAGNOLIACEÆ.

LIRIODENDRON, L. Tulip-tree.

L. TULIPIFERA, L.

Scarce in the western but frequent in the eastern part of the county, where many of the largest trees in the primeval forest were of this species. Lakeside. Commonly called White-wood and improperly, Yellow Poplar and White Poplar. The wood suitable for pumps, troughs and hollow ware.

MAGNOLIA, L.

M. ACUMINATA, L. Cucumber-tree.

Two trees near the iron bridge across east branch of Vermillion River. "Big woods, Perkins."

AMONACEÆ.

ASIMINA, Adans.

A. TRILOBA, Dunal. North American Papaw.

Not found near Sandusky, but near Milan and in many places east from there to the Vermillion River, especially along the Old Woman Creek and other streams. Also in the forest west of Castalia in Sandusky Co. "Formerly on Kelley's Island."

RANUNCULACEÆ.

ACTÆA, L.

A. ALBA, Mill. White Baneberry.

Frequent.

A. SPICATA RUBRA, Ait. Red Baneberry.

Cedar Point, Perkins, Margaretta Ridge; scarce. "Berlin."

ANEMONE, L.

A. ACUTILOBA, Laws. (Hepatica acutiloba, D C.) Liver-leaf.
Frequent. Islands.

A. CYLINDRICA, Gray. Long-fruited Anemone.
Infrequent but observed in eight townships.

A. DICHOTOMA, L. (A pennsylvanica, L.)
Common. All islands, except Kelley's.

A. HEPATICA, L. (Hepatica triloba, Chaix) Liver-leaf.
Frequent. Not observed in Florence where A. *acutiloba* is rather common. Islands. Both species more frequent on the Peninsula than in Erie Co.

A. NEMOROSA, L. Wind-flower. Wood Anemone.
Common.

A. THALICTROIDES, L. Rue-Anemone.
Common. Sometimes double. In blossom as late as September.

A. VIRGINIANA, L.
Frequent. Islands.

AQUILEGIA, L. Columbine.

A. CANADENSIS, L.
Not noticed near Sandusky, except on Cedar Point, but common among rocks on the Peninsula and Islands and at Margaretta Ridge. Berlin, Vermillion, Florence. Adorns the rocky shores of the islands.

CALTHA, L. Marsh Marigold.

C. PALUSTRIS, L.
Frequent.

CIMICIFUGA, L. Bugbane.

C. RACEMOSA, Nutt. Black Snakeroot. Black Cohosh.
Common in woods in eastern part of Erie Co, and extending west to Perkins.

CLEMATIS, L. Virgin's Bower

C. VIRGINIANA, L.
Frequent. North Bass.

DELPHINIUM, L. Larkspur.

D. *ajacis*, L.
Spontaneous in gardens and near them.

D. AZUREUM, Michx.
One plant found by L. S. & M. S. Ry. between Venice and Bay Bridge, by Will Newberry. Probably adventive.

HYDRASTIS, Ellis. Orange-root.

H. CANADENSIS, L. Golden Seal.
Frequent in rich woods long undisturbed. "Kelley's Island." "Catawba."

ISOPYRUM, L.

I. BITERNATUM, Torr & Gray.
Vermillion River, southeren Florence; scarce. "Huron River at Norwalk" Leslie D. Stair.

NIGELLA, L.

N. *damascena*, L. Fennel-flower.
Spontaneous in gardens and rarely escaped.

RANUNCULUS, L. Crowfoot. Buttercup.

R. ABORTIVUS, L. Small-flowered Crowfoot.
Common.

R. *acris*, L. Tall or Meadow Buttercup.
Florence, Berlin, Huron, Sandusky, Put-in-Bay; infrequent.

R. CIRCINATUS, Sibth. Stiff Water Crowfoot.
Sandusky Bay, Castalia, Mill's Creek; frequent.

R. FASCICULARIS, Muhl. Early Buttercup.
Margaretta, Huron, Peninsula, Johnson's Island, Kelley's Island; locally plentiful.

R. MULTIFIDUS, Pursh.
House's swamp, Perkins; Castalia; Peninsula; Islands; infrequent.

R. OBTUSIUSCULUS. Raf. (R. ambigens, Watson,) Water Plantain Spearwort.
Millan and Florence; rare.

R. PENNSYLVANICUS, L. f. Bristly Buttercup.
Sandnsky and Willow Point near the Bay, Catawba; rare.

R. RECURTATUS, Poir. Hooked Crowfoot.
Frequent, especially along rivers.

R. SCELERATUS, L. Cursed Crowfoot.
Frequent. Islands.

R. SEPTENTRIONALIS, Poir. Swamp or Marsh Buttercup.
Common. Kelley's and "Put-in-Bay" the only islands.

THALICTRUM, L. Meadow-Rue.

T. DIOICUM, L. Early Meadow-Rue.
Common.

T. POLYGAMUM, Muhl. Tall Meadow-Rue.
Frequent.

T. PURPURASCENS, L. Purplish Meadcw-Rue.
Frequent, especially near Castslia.

BERBERIDACEÆ.

BERBERIS, L. Barberry.

B. VULGARIS, L. Common Barberry.
Woods, Milan and Huron; rare. Seeds probably dropped by birds.

CAULOPHYLLUM, Michx. Blue Cohosh.

C. THALICTROIDES, Michx.
Florence, Vermillion, Berlin, Perkins, Johnson's Island; infrequent.

JEFFERSONIA, Barton. Twin-leaf.

J. BINATA, Barton, (J. DIPHYLLA, Pers.)
Johnson's Island, but nowhere else near Sandusky. Lockwood's woods, Peninsula. Several places along Vermillion River, Florence.

PODOPHYLLUM, L. Mandrake.

P. PELTATUM, L. May-Apple.
Abundant. Fruit edible. "Leaves and roots poisonous." Gray.

MENISPERMACEÆ.

MENISPERMUM, L. Moonseed.

M. CANADENSE, L.
Frequent. Islands.

LAURACEÆ.

LINDERA, Thumb.

L. BENZOIN, Meisn. Spice-bush. Benjamin-bush.
In rich woods in Erie County the most abundant shrub.

SASSAFRAS, Nees.

S. OFFICINALE, Nees.
Frequent. "Formerly on the Islands." Submerged trunks found in Huron Marsh. See page 15. Some trees on the Peninsula measured by J. R. Kelly have trunks with circumferences as follows: 8 ft. 1 in.; 7½ft.; 6 ft. 10 in.; 6 ft. Formerly sassafras oil was made in Sandusky.

PAPAVERACEÆ.

CHELIDONIUM, L. Celandine.

C. *majus*, L.
Scarce.

PAPAVER, L. Poppy.

P. *argemone*, L. Rough-fruited Corn-Poppy.
"In a Crimson Clover field, Perkins." Ross Ransom. Probably adventive.

P. *somniferum*, L. Opium Poppy.
Along a railroad, Sandusky; rare and adventive.

SANGUINARIA, Dell. Blood-root.

S. CANADENSIS, L.
Frequent. Islands.

FUMARIACEÆ.

CORYDALIS, Vent.

C. AUREA, Willd. Golden Corydalis.
"Port Clinton," Leslie D. Stair.

C. FLAVULA, D C.
Peninsula and Islands including Johnson's. "Cedar Point." Krebs.

DICENTRA, Borkh.

D. CANADENSIS, Walp. Squirrel Corn.
Berlin, Florence, Milan, Perkins; rare. "Vermillion" Otto K. Todd.

D. CUCULLARIA, Bernh. Dutchman's Breeches.
Frequent. All the Islands.

FUMARIA, L. Fumitory.

F. *officinalis, L.*
Sandusky, Cedar Point, Kelley's Island; rare.

CRUCIFERÆ.

ALYSSUM, L.

A. CALYCINUM, L.
"Catawba" Nettie Schnaitter.

ARABIS, L. Rock Cress.

A. CANADENSIS, L. Sickle-pod.
Perkins, Margaretta, Peninsula, Johnson's Island, Put-in-Bay. Middle Bass; infrequent.

A. DENTATA, Torr & Gray.
Cedar Point, Florence, Johnson's Island, North Bass, Green Island; infrequent.

A. DRUMMONDII, Gray. (A. CONFINIS. Watson.)
Cedar Point and Islands; frequent.

A. HIRSUTA, Scop.
Marblehead; common. Catawba. Mouse Island, Margaretta, Huron River.

A. LÆVIGATA. DC.
Frequent. Islands.

A. LYRATA. L.
Cedar Point; common. Perkins, Marblehead.

A. PERFOLIATA, Lam. Tower Mustard.
Johnson's Island; rare.

BARBAREA, R. Br. Winter Cress.

B. VULGARIS, R. Br. Yellow Rocket.
Frequent, Green Island. Some of the specimens, at least, belong to the "variety" *stricta*, which may be distinct.

BRASSICA, L.

B. *napus*, L. Rape.
Sandusky, Vermillion; adventive.

B. *nigra*, Kock. Black Mustard.
Common.

B. *sinapistrum*, Boiss. Charlock.
Abundant.

CAKILE, Tourn. Sea-Rocket.

C. MARITIMA, Scop. (C. AMERICANA, Nutt.)
Shores of Lake and Bay; common.

CAMELINA, Crantz. False Flax.

C. *sativa*, Crantz.
Sandusky and Avery; rare.

CAPSELLA, Medic. Shepherd's Purse.

C. *bursa-pastoris*, Medic.
Abundant.

CARDAMINE, L. Bitter Cress.

C. DIPHYLLA, Wood. Two-leaved Toothwort.
Huron River near Millan; rare. Florence; scarce. "Berlin Heights" Chas. Judson.

C. LACINIATA, Wood. Toothwort. Pepperroot.
Common.

C. PENNSYLVANICA, Muhl.
Frequent. Kelley's Island. North Bass.

C. RHOMBOIDEA, DC. Spring Cress.
Common.

C. RHOMBOIDEA PURPUREA, Torr.
Common.

COCHLEARIA, L.

C. *armoracia*, L. (Nasturtium *arnoracia*, *Fries*.) Horseradish.
Frequent. Islands.

CONRINGIA, Link.

C. *orientalis*, Dum.* Hare's-ear Mustard.
Four plants found along railroad near ice houses, eastern Sandusky, 1897, by Geo. Gilbert.

DRABA, Dill. Whitlow-Grass.

D. CAROLINIANA, Walt.
Common on Marblehead and in some places in Margaretta in thin soil overlying the limestome.

D. *verna*, L.
"Perkins," Lindsey House. rare.

ERYSIMUM, L. Treacle Mustard.

E. PARVIFLORUM, Nutt.*
One place along L. E. & W. Ry., west of Castalia; rare.

LEPIDIUM, L Pepperwort. Peppergrass.

L. APETALUM, Willd. (L. INTERMEDIUM, Gray.)
Sandusky; infrequent.

L. *campestre*, R. Br.
Sandusky, Perkins, Margaretta, Peninsula, Kelley's Island, Put-in-Bay. Common in places, especially on the Peninsula.

L. VIRGINICUM, L. Wild Peppergrass.
Common.

NASTURTIUM, R. Br. Water-Cress.

N. LACUSTRE, Gray. Lake Cress.
Shinrock; rare.

N. *officinale*, R. Br. True Water-Cress.
Castalia; frequent.

N. PALUSTRE, D C. Marsh Cress.
Common. On the Islands, and generally near the Lake or Bay, the variety *hispidum* is more common.

N. *sylvestre*, R. Br.* Yellow Cress.
Four places in Perkins, three of them near or not far from Pipe Creek.

SISYMBRIUM, L.

S. *alliaria*, Scop.
"Kelley's Island." Probably adventive.

S. CANESCENS, Nutt. Tansy Mustard.
Cedar Point, Marblehead, Islands; frequent.

S. *officinale*, Scop. Hedge Mustard.
Common.

THLASPI, L.

T. *arvense*, L. Field Pennycress.
Sandusky; rare and adventive.

CAPPARIDACEÆ.

CLEOME, L.

C. GRAVEOLENS, Raf. (POLANISIA GRAVEOLENS, Raf.)
Common on sandy beaches. Also in gravel along L. E. & W. R. R.

RESEDACEÆ.

RESEDA, L. Mignonette.

R. *lutea*, L.
Sandusky, Kelley's Island; rare and adventive.

DROSERACEÆ.

DROSERA, L. Sundew.

D. ROTUNDIFOLIA, L.
East of Milan; very rare.

CRASSULACEÆ.

PENTHORUM, Gronov. Ditch Stone-crop.

P. SEDOIDES, L.
Frequent. Islands.

SEDUM, L. Stone-crop. Orpine.

S. *acre*, L. Mossy Stone-crop.
Kelley's Island, roadside by the cemetery. Cedar Point near the Light House. Escaped.

S. *telephium*, L. Orpine. Live-for-ever.
Bogart, Castalia, and Sandhill cemeteries. Put-in-Bay, North Bass, "Marblehead" U G. Sanger

S. TERNATUM, Michx. Wild Stone-crop.
Frequent at the foot of steep shale banks of streams. Put-in-Bay. Gibraltar.

SAXIFRAGACÆ.

CHRYSOSPLENIUM, L. Golden Saxifrage.

C. AMERICANUM, Schwein.
Vermillion River, Florence; two places.

HEUCHERA, L. Alum-root.

H. AMERICANA, L.
Common.

MITELLA, L. Bishop's-Cap. Mitrewort.

M. DIPHYLLA, L.
Infrequent.

PARNASSIA, L. Grass of Parnassus.

P. CAROLINIANA, Michx.
Castalia; frequent. Perkins, Milan, Florence; rare.

PHILADELPHUS, L.

P. *coronarius*, L. Mock Orange. Syringa.
Sparingly escaped at Sandusky and Berlin Heights.

SAXIFRAGA, L. Saxifrage.

S. PENNSYLVANICA, L. Swamp Saxifrage.
Milan and Florence; scarce.

TIARELLA, L. False Mitrewort.

T. CORDIFOLIA, L.
East fork, Vermillion River; rare.

GROSSULARIACEÆ.

RIBES, L.

R. AUREUM, Pursh. Missouri or Buffalo Currant.
Well established on south side of Kelley's Island.
Roadside near a house in Margaretta.

R. CYNOSBATI. L, Gooseberry.
Common.

R. FLORIDUM, L'Her. Wild Black Currant.
Infrequent. Kelley's Island.

R. LACUSTRE, Poir.
"Cedar Point." Millie Carter.

HAMAMELIDACEÆ.

Hamamelis, L. Witch-Hazel.

H. VIRGINIANA, L.
Florence, Vermillion, Berlin, Milan; frequent. "Portage River."

PLATANACEÆ.

PLATANUS, L. Sycamore.

P. OCCIDENTALIS, L. Buttonwood.
Frequent. Islands. The largest tree in Erie county is probably the buttonwood six miles south of Sondusky, in the woods, but near the road and a little east of Pipe Creek.

ROSACEÆ.

AGRIMONIA, L. Agrimony.

A. EUPATORIA, L.
Common. Kelley's the only Island.

A. MOLLIS, Torr. & Gray.
Perkins and doubtless elsewhere.

A. PARVIFLORA, Soland.
Frequent. In places, abundant.

A. STRIATA Michx.
Margaretta Ridge. Probably elsewhere.

FRAGARIA, L. Strawberry.

F. VESCA, L.
Peninsula, Kelley's Island, Put-in-Bay, Cedar Point, Margaretta, Berlin; frequent in rocky places.

F. VIRGINIANA, Duchesne.
Common. Kelley's, Put-in-Bay and Mouse the only Islands. Many specimens answer to description of the "variety" *illinoense.*

GEUM, L. Avens.

G. ALBUM, Gmelin.
Common.

G. STRICTUM, Soland.
Southern Perkins; rare.

G; VERNUM, Torr. & Gray.
Johnson's Island, Marblehead, Berlin, Perkins, etc.; rather frequent.

G. VIRGINIANUM, L.
Frequent. Kelley's Island? Put-in-Bay.

NEILLIA, D. Don. Ninebark.

N. OPULIFOLIA, Benth. & Hook.
Common on rocky shores of Peninsula and Islands. Vermillion River; rare.

POTENTILLA, L. Cinquefoil.

P. ANSERINA, L. Silver-weed.
Common on sandy shores of Lake and Bay, back a few yards from the water. Middle Bass, North Bass, Rattlesnake Island.

P. ARGUTA, Pursh.
Marblehead, Port Clinton, Put-in-Bay, Margaretta Ridge, Krieger's, Perkins; infrequent.

P. CANADENSIS, L. Five-finger.
Common. Not on the Islands.

P. FRUTICOSA, L. Shrubby Cinquefoil.
Castalia prairie; common. In blossom as late as October 10th.

P. NORVEGICA, L.
Frequent. In places abundant. Put-in-Bay.

P. SUPINA, L.
Huron and several places about Sandusky Bay.

ROSA, L. Rose.

R. BLANDA, Ait.
Cedar Point, Oxford, Groton, Margaretta; local.

R. CAROLINA, L.
Common.

R. HUMILIS, Marsh.
Common. Kelley's and Put-in-Bay the only Islands.

R. *rubiginosa*, L. Sweetbrier. Eglantine.
Frequent. Islands.

R. SETIGERA, Michx. Climbing or Prairie Rose.
Perkins, Groton, Cedar Point, Johnson's Island, Peninsula, Mouse Island, Kelley's Island, Middle Bass; common. Well worth cultivating.

RUBUS, L. Bramble.

R. CANADENSIS, L. Low Blackberry, Dewberry.
Common.

R. HISPIDUS, L. Running Swamp Blackberry.
East of Milan, Berlin, Vermillion, Joseph Smith's, Perkins; local.

R. OCCIDENTALIS, L. Black Raspberry. Thimbleberry.
Common.

R. ODORATUS, L. Purple-flowering Raspberry.
"Near Vermillion River north of Birmingham" Mrs. W. H. Olds. I have seen this handsome species at Buffalo, Ashtabula, Cleveland and in Lorain County within a few rods of Erie County, but no farther west.

R. SETOSUS, Bigel.* Bristly Blackberry.
Prairie, Oxford and Perkins; common.

R. STRIGOSUS, Michx. Wild Red Raspberry.
Old huckleberry swamp near Axtell; rare. "Other places"?

R. TRIFLORUS, Richardson. Dwarf Raspberry.
German settlement, Perkins, and east fork of Vermillion River; rare. Also in the forest west of Castalia, in Sandusky County.

R. VILLOSUS, Ait. High Blackberry.
Common.

SPIRÆA, L. Meadow-Sweet.

S. LOBATA, Jacq.* Queen of the Prairie.
Southwest of Castalia; local.
A beautiful plant.

S. SALICIFOLIA, L. Common Meadow-sweet.
Oxford, Perkins, Milan, Florence; infrequent.

S. TOMENTOSA, L. Hardhack. Steeple-Bush.
Oxford prairie; very rare.

POMACEÆ.

AMELANCHIER, Medic. June-berry.

A. CANADENSIS, Torr & Gray. Shad-bush. Service-berry.
Frequent. Islands.

A. OBLONGIFOLIA, Torr & Gray.
Cedar Point, Mouse Island, Kelley's Island; scarce.

CRATÆGUS, L. Thorn.

C. COCCINEA, L.
Common. Put-in-bay; scarce. North Bass. No other islands.

C. CRUS-GALLI. L. Cockspur Thorn.
Frequent.

C. *oxyacantha*, L. English Hawthorn.
In a thicket, Vermillion and two places in Huron. Seed probably dropped by birds.

C. PUNCTATA, Jacq.
Perkins, Shinrock, Florence. Frequent in Florence. "Marblehead" Gertrude Johnson.

C. SUBVILLOSA, T. & G. (C. COCCINEA MOLLIS, T. & G.)
Common. Kelley's the only Island.

C. TOMENTOSA, L.
Infrequent. Kelley's Island. Middle Bass.

PYRUS, L.

P. AMERICANA, D C.* American Mountain-Ash.
In thickets, Rattlesnake Island, Put-in-Bay and several places in Erie County. Doubtless from seeds dropped by birds.

P. ANGUSTIFOLIA, Ait.*
"Margaretta" Flossie Nolan. Perkins, scarce.

P. ARBUTIFOLIA, L. f. Choke-berry.
Tisdell's, Vermillion; rare.

P. ARBUTIFOLIA MELANOCARPA, Hook.
Milan, Berlin, Vermillion, Marblehead; infrequent

P. *communis*, L. Pear.
In woods or by roadsides, Perkins, Groton, Catawba, Put-in-Bay; rare. "Kelley's Island."

P. CORONARIA, L. American Crab-Apple.
Frequent. Put-in-Bay.

P. *malus*, L. Apple.
Frequent. Islands.

DRUPACEÆ.

PRUNUS, L.

P. AMERICANA, Marshall. Wild Yellow or Red Plum.
Rather frequent. Kelley's Island. Put-in-Bay.

P. *avium*, L. Sweet Cherry.
In several woods where, doubtless, it has started from pits dropped by birds. Kelley's Island.

P. CUNEATA, Raf.*
Oxford prairie; rare.

P. *persica*, Stokes. Peach.
Roadsides; infrequent. Islands. 300,000 bnshels of peaches, raised on Catawba, were shipped from there in 1898, enough to have supplied more than a peck to every family in the western half of the United States.

P. SEROTINA, Ehrh. Wild Black Cherry.
Common. Timber found in the submerged forest, Huron marsh. Mr. W. H. Todd says that these cherries are more attractive to birds than grapes, and that it pays to plant the trees near vineyards for this reason. Are they not worth planting for the timber?

P. VIRGINIANA, L. Choke-Cherry.
Abundant on Cedar Point and Islands. Much less common elsewhere.

CÆSALPINACEÆ.

CASSIA, L. Senna.

B. CHAMÆCRISTA, L. Partridge Pea.
Common on the shale in Oxford, Perkins, and Huron near the "slate" cut. Infrequent along railroads in Sandusky. Catawba.

C. MARYLANDICA, L. Wild Senna.
Margaretta, Johnson's Island, Marblehead; infrequent. "Port Clinton."

CERCIS, L. Judas-tree.

C. CANADENSIS, L. Red-bud.
Peninsula; frequent. Margaretta; infrequent. Milan; scarce.

GLEDITSCHIA, L. Honey-Locust.

G. TRIACANTHOS, L. Three-thorned Acacia. Honey-Locust.
Common, especially near Sandusky and in Ottawa county. A tree of great expanse stands on Osborn St. near Hayes Ave.

GYMNOCLADUS, Lam. Kentucky Coffee-tree.

G. CANADENSIS, Lam.
Distribution peculiar and the tree not generally known. It grows on all of the eight islands on

which I have collected, yet on Put-in-Bay seems limited to one spot near the south point. Marblehead, one standing by the side of the principal street; Catawba; Port Clinton where Dr. Hitchcock said there were fifty on one acre, Margaretta, several places; Perkins, Gurley's; Huron, one by the Sandusky road; Berlin, formerly on Sterling Hill's place and elsewhere; Vermillion, near Axtel; Florence, near Terryville.

PAPILIONACEÆ

AMPHICARPÆA, Ell. Hog Pea-nut.

A. MONOICA, Ell.
Common.

A. PITCHERI, Torr & Gray.*
Perkins, Milan, Cedar Point, Catawba, Islands; frequent.

APIOS, Boerhaave. Ground-nut. Wild Bean.

A. TUBEROSA, Moench.
Rather frequent. "Tubers edible."

ASTRAGALUS, L. Milk-Vetch.

A. CANADENSIS, L.
Shores of the Islands and about Sandusky Bay; frequent.

BAPTISIA, Vent. False Indigo.

B. LEUCANTHA, Torr & Gray.
Oxford and southern Perkins; infrequent.

B. TINCTORIA, R. Br. Wild Indigo.
Oxford, Perkins, eastern Milan, Vermillion, Florence; infrequent.

DESMODIUM, Desv. Tick-Trefoil.

D. ACUMINATUM, DC.
Common. Not on the Islands. Some specimens show a reversion of loments to leaves. See sixth annual report, page 32.

D. CANADENSE, DC.
Frequent.

D. CANESCENS, DC.
Common.

D. CILIARE, DC.
Margaretta Ridge, Berlin Heights, east of Milan and Joseph Smith's woods, Perkins; infrequent.

D. CUSPIDATUM, Hooker.
Infrequent.

D. DILLENII, Darlingt.
Frequent. Put-in-Bay.

D. ILLINOENSE, Gray.*
Marblehead, Margaretta, southern Perkins; scarce.

D. LINEATUM, DC.*
Joseph Smith's woods, Perkins; local.

D. MARYLANDICUM, F. Boott.
Margaretta Ridge; rare.

D. NUDIFLORUM, DC.
Frequent.

D. PANICULATUM, DC.
Frequent. Put-in.Bay.

D. RIGIDUM, DC.
Infrequent.

D. ROTUNDIFOLIUM DC.
Rather frequent in sandy woods, occurring in, at least, fourteen places in Erie County and on the Peninsula.

D. SESSILIFOLIUM, Torr. and Gray.*
Sandy fields on Margaretta Ridge; common. Sandhill cemetery. Also ten miles west of Toledo.

LATHYRUS, L. Vetchling.

L. MYRTIFOLIUS, Muhl.
Huron River near Enterprise. "L. S. & M. S. Ry. Sandusky," Elmer Unchrich.

L. OCHROLEUCUS, Hook.
Peninsula and Islands.

L. PALUSTRIS, L.
Common.

L. VENOSUS, Muhl.*
Margaretta Ridge; considerable.

LESPEDEZA, Michx. Bush-Clover.

L. CAPITATA, Michx.
Common, at least in sandy soil.
Not on the Islands.

L. NUTTALLII, Darl.*
Margaretta Ridge.

L. POLYSTACHYA, Michx.
Margaretta Ridge, East of Milan, Berlin Heights, Vermillion, Florence; frequent.

L. PROCUMBENS, Michx.
Vermillion; rare.

L. RETICULATA, Pers.
Margaretta, Huron, Marblehead, Catawba.

L. STUVEI INTERMEDIA, Watson.
Frequent.

L. VIOLACEA, Pers.
Frequent.

LUPINUS, L. Lupine.

L. PERENNIS, L. Wild Lupine.
Margaretta Ridge; Joseph's Smith's, Perkins; east of Milan; local. "Scott's cemetery" Gertrude Taylor.

MEDICAGO, L. Medick.

M. *lupulina*, L. Black Medick. Nonesuch.
Frequent. Islands.

M. *sativa*, L. Lucerne. Alfalfa.
Sandusky, Perkins, Marblehead, Put-in-Bay; roadsides, scarce. Can be raised in the dry soil of the Peninsula and Islands.

MELILOTUS, Juss. Melilot. Sweet Clover.

M. *alba* Desv. White Melilot.
Abundant.

M. *officinalis*, Lam. Yellow Melilot.
Sandusky, Johnson's Island, Put-in-Bay; infrequent.

PHASEOLUS, L.

P. DIVERSIFOLIUS, Pers. (STROPHOSTYLES ANGULOSA, Ell.) Trailing Wild Bean.
Common on sandy shores. Islands.

PSORALEA, L.

P. MELILOTOIDES, Michx.*
Bloomingville cemetery and southeast of Kimball; indigenous but rare.

ROBINIA, L. Locust-tree.

R. PSEUDACACIA, L. Common Locust. False Acacia.
Infrequent. Islands. Naturalized on banks of Huron River and elsewhere.
The first tree of this species taken to Europe, 1638, was still standing in the *Jardin des Plantes*, Paris, in 1890.

TEPHROSIA, Pers. Hoary Pea.

T. VIRGINIANA, Pers. Goat's Rue. Cat-gut.
Castalia cemetery.

TRIFOLIUM, L. Clover.

T. HYBRIDUM, L. Alsike Clover.
Frequent. Put-in-Bay.

T. *pratense*, L. Red Clover.
Common.

T. REFLEXUM, L.* Buffalo Clover.
"Johnson's Island." Minnie Matern.

T. REPENS, L. White Clover.
Common.

VICIA, L. Vetch.

V. AMERICANA, Muhl.
Sandusky, especially along L. S. & M. S. R. R. west of Hancock St., Margaretta Ridge, Catawba, Kelley's Island, North Bass; local.

V. CAROLINIANA, Walt.
Islands, Peninsula and western part of Erie county; common.

V. *sativa*, L.
Lakeside, North Bass, Rattlesnake Island; rare.

GERANIACEÆ.

ERODIUM, L'Her. Storksbill.

E. *cicutarium*, L'Her.
"East of Milan." Will Bittner.

GERANIUM, L. Cranesbill.

G. CAROLINIANUM, L.
Frequent in cultivated ground. Islands.

G. MACULATUM, L. Wild Cranesbill.
Common. Kelley's the only Island.

G. ROBERTIANUM, L. Herb Robert.
Common in rocky woods on the Peninsula and all the Islands. In sand, Cedar Point; frequent. Florence, but scarce so far from the Lake. Seldom if ever seen in the interior of Ohio or Michigan. I have seen it in Great Britain, where it is also native but not so common as on our Islands and Peninsula. Here it probably thrives better than anywhere farther south in America. It blooms from May till late in October and adds much to the beauty of woodland and rocky shores.

OXALIDACEÆ.

OXALIS, L. Wood-Sorrel.

O. CYMOSA, Small.
Common.

O. STRICTA, L.
Common.

O. VIOLACEA, L. Violet Wood-Sorrel.
Frequent along a stream in south-eastern Milan and in woods in southern Perkins. Infrequent in Berlin, Huron, near the Soldiers' Home and near the West Harbor. "Florence."

LINACEÆ.

LINUM, L. Flax.

L. SULCATUM.
Widder's woods and Castalia cemetery, Margaretta; Sandhill cemetery; Latham's, Catawba; rare.

L. *usitatissimum*, L. Common Flax.
Along railroads; infrequent. Kelley's Island.

L. VIRGINIANUM, L.
Dry unbroken ground, especially at the top of high steep banks, Oxford and east; scarce.

RUTACEÆ.

PTELEA, L. Hop-tree.

P. TRIFOLIATA, L. Shrubby Trefoil.
Common on the Islands and generally on sandy shores of the Lake. Occurs also in Florence and Margaretta. One on Cedar point has a circumference of thirty-four inches, one foot above the ground.

ZANTHOXYLUM, L. Prickly Ash.

Z, AMERICANUM, Mill. Prickly Ash. Toothache-tree.
Perkins, Groton, Cedar Point, Marblehead, Port Clinton, Kelley's Island, Middle Bass; frequent.

SIMARUBACEÆ.

AILANTHUS, Desf. Tree-of-Heaven.

A. *glandulosa*, Desf. Chinese Sumach.
Naturalized on Cedar Point and in many places in Sandusky, especially about lumber yards and near buildings where the shelter from wind, the reflected sunlight and the protection afforded by the Bay from untimely frosts enable it to thrive better than in most places so far north. Woods, Florence, and creek valleys, Berlin; rare.

POLYGALACEÆ.

POLYGALA, L. Milkwort.

P. SANGUINEA, L.
Abundant on the shale, Oxford and southern Perkins. Huron, south-east of Milan, Berlin, Vermillion; locally common.

P. SENEGA, L.
Margaretta Ridge, Marblehead, Perkins cemetery; scarce. The variety *latifolia* grows at Catawba.

P. VERTICILLATA, L.
Dry soil, especially at the top of steep banks; infrequent.

P. VERTICILLATA AMBIGUA, Wats & Coult.
South of Huron; rare.

EUPHORBIACEÆ.

ACALYPHA, L. Three-seeded Mercury.

A. VIRGINICA, L.
Abundant.

EUPHORBIA, L. Spurge.

E. COMMUTATA, Engelm.
Marblehead, Johnson's Island, Cedar Point, Willow Point; rare except near the railroad on Marblehead.

E. COROLLATA, L.
Frequent.

E. *cyparissias*, L. Cypress Spurge.
Spreading in and from cemeteries and yards. Islands.

E. DENTATA, Michx.*
Islands, Peninsula and mainland near Sandusky Bay; frequent.

E. HIRSUTA, Wiegand.*
Common, but not on the Islands.

E. MACULATA, L.
Abundant.

E. MARGINATA, Pursh.
Naturalized in flower gardens, frequent; elsewhere rare.

E. *peplus*, L.*
Along fence, Jefferson St., near Fulton St., Sandusky, where it has been for a number of years.

E. POLYGONIFOLIA, L.
Abundant on sandy shores of Lake Erie. Islands.

E. PRESLII, Guss.
Common.

E. SERPENS, HBK.*
Johnson's Island; rare. A lot in Sandusky, vacant in 1896, but since used for a building site.

CALLITRICHACEÆ.

CALLITRICHE, L. Water-Starwort.

C. HETEROPHYLLA, Pursh.
Berlin; rare.

C. VERNA, L.
Birmingham and Kimball; rare.

LIMNANTHACEÆ.

FLŒRKEA, Willd. False Mermaid.

F. PROSERPINACOIDES, Willd.
Common in alluvial soil.

ANACARDIACEÆ.

RHUS, L. Sumach.

R. AROMATICA, Ait. Fragrant Sumac.
Cedar Point and Marblehead; common. Other parts of the Peninsula, Islands, Margaretta, western Perkins; frequent.

R. COPALLINA, L. Dwarf Sumac.
Oxford and southern Perkins; common. Southeast of Milan.

R. GLABRA, L. Smooth Sumac.
Common.

R. RADICANS, L. (R. TOXICODENDRON,) Poison Ivy.
Everywhere except on Green Island. Common. Berries eaten and seeds distributed by birds.

R. TYPHINA, L. Staghorn Sumac.
Islands, Peninsula and Cedar Point; abundant. Lester Carpenter of Kelley's Island has bookshelves of this wood, and says that one tree was sixteen inches in diameter near the ground, and about fourteen inches, at a height of six feet. Where else does sumac attain such a size?

R. VENENATA, DC. Poison Sumac.
Vermillion; almost exterminated. "Formerly in old huckleberry swamp near Axtel" A. A. Blair and L. W. Washburn.

ILICACEÆ.

ILEX, L. Holly.

I. VERTICILLATA, Gray. Winterberry. Black Alder.
Rather frequent. Green Island.

CELASTRACEÆ.

CELASTRUS, L. Shrubby Bitter sweet.

C. SCANDENS, L. Wax-work, Climbing Bitter-sweet.
Common.

EUONYMUS, L. Spindle-tree.

E. ATROPURPUREUS, Jacq. Burning-Bush. Wahoo.
Frequent. Kelley's Island.

E. OBOVATUS, Nutt. Running Strawberry Bush.
Islands; Sugar Rock, Catawba; Hartshorn's; frequent. Vermillion River, Florence.

STAPHYLEACEÆ.

STAPHYLEA, L. Bladder-nut.

S. TRIFOLIA, L. American Bladder-nut.
Frequent. Green Island.

ACERACEÆ.

ACER, L. Maple.

A. DASYCARPUM, Ehrh. White or Silver Maple.
Common. Planted for shade.
Wood used in Sandusky in making baskets.

A. RUBRUM, L. Red or Swamp Maple.
River banks; infrequent.

A. SACCHARINUM, Wang. Sugar or Rock Maple.

Common in Florence, where there are many sugar bushes. Less common in other parts of the county, on the Peninsula and all the Islands. Wood used by the Sandusky Furniture Company for making bowling alleys, and by the Tool Company for the jaws of hand-screws.

A. SACCHARINUM NIGRUM, Torr & Gray. Black Sugar Maple.

Frequent. Kelley's Island. North Bass.

N. NEGUNDO, Moench. Ash-leaved Maple. Box Elder.

N. ACEROIDES, Moench.

Vermillion River, Huron River, Pipe Creek, Shinrock, Bay Bridge, Port Clinton, Put-in-Bay; scarce except along rivers.

HIPPOCASTANACEÆ.

AESCULUS, L.

Æ. GLABRA, Willd. Fetid or Ohio Buckeye.

Frequent along streams and on Johnson's Island. Marblehead, Kelley's Island; scarce. Middle Bass, one. "North Bass, one." "Buckeye Island, formerly."

BALSAMINACEÆ.

IMPATIENS, L. Balsam. Jewel-weed.

I. AUREA, Muhl. (I. PALLIDA, Nutt.) Pale Touch-me-not.

Frequent in rich soil in damp woods. Rattlesnake Island.

I. BIFLORA, Walt. (I. FULVA, Nutt.) Spotted Touch-me-not.

Common, especially on Cedar Point and shores of the Islands.

RHAMNACEÆ.

CEANOTHUS, L. Red-root.

C. AMERICANUS, L. New Jersey Tea.
Peninsula, Margeretta Ridge, Perkins, Oxford, east of Milan; frequent.

C. OVATUS, Desf.
Peninsula; frequent.

VITACEÆ.

VITIS, L. Grape.

V. BICOLOR, LeConte. Blue or Winter Grape.
Infrequent. A vine in Peter Mainzer's woods, German Settlement, Perkins, is about 80 feet high and measures 28¼ inches in circumference.

V. CORDIFOLIA, Michx. Frost or Chicken Grape.
Milan, Berlin, Vermillion; rather frequent. Johnson's Island.

V. HEDERACEA, Ehrh. (AMPELOPSIS QUINQUEFOLIA, Michx.) Virginia Creeper.
Common.

V. LABRUSCA, L. Northern Fox Grape.
Vermillion, Florence, Berlin, Milan, Oxford. Rather frequent in Florence.

V. RIPARIA, Michx. Riverside or Sweet scented Grape.
Common. Abundant on Cedar Point. Nearly all the wild grape vines near Sandusky and on the Islands and Peninsula are of this species. Wild grapes formerly abounded on the Islands. Vineyards have for many years occupied half or more of the cultivated ground of the Islands,—more than half the entire area of Middle Bass and North Bass. Of late they have been to some extent supplanted by peach orchards. The yield continues good,—between six and nine million pounds annually for Ottawa county, surpassed the last few years by Lake and Cuyahoga counties,—but the price has been low.

TILIACEÆ.

TILIA, L. Linden.

T. AMERICANA, L. Basswood.
Common. Wood used in Sandusky for making excelsior and small boxes. Crayon made in Sandusky is used in nearly every school-house in the United States and to some extent in Europe. For the crayon boxes, basswood logs four feet long, steamed and stripped of bark, are revolved in front of a knife that peels off long sheets of the required thickness. The cores of the logs, about six inches thick, are sent to Muncie, Indiana, for making paper pulp.

MALVACEÆ.

ABUTILON, Gaertn. Indian Mallow.

A. *avicennae*, Gaertn. Velvet-Leaf.
Common. Cultivated in western China for its fibre: here a garden weed.

ALTHÆA.

A. *rosea*, Cav. Hollyhock.
Escaped into streets and vacant lots in a hundred places, in Sandusky; also in many other places in Erie county and on the Islands and Peninsula.

HIBISCUS, L. Rose-Mallow.

H. MOSCHEUTOS, L. Swamp Rose-Mallow.
In marshes connected with Sandusky Bay and the Harbors; frequent. Port Clinton. North Bass. A showy plant.

H. *trionum*, L. Bladder Ketmia. Flower-of-an-Hour. Venice Mallow. Black-eyed Susan.
Frequent. Not yet well known, but occurring throughout Frie county, on the Peninsula and on Kelley's Island. Plentiful in some places.

MALVA, L. Mallow.

M. *moschata*, L. Musk Mallow.
Scarce. Kelley's Island.

M. *rotundifolia*, L. Common Mallow.
Abundant.

M. *sylvestris*, L. High Mallow.
Rare.

SIDA, L.

S. *spinosa*, L.
Sandusky, Perkins, Peninsula; local. Kelley's Island; frequent.

HYPERICACEÆ.

HYPERICUM, L. St John's-wort.

H. ASCYRON, L. Great St. John's-wort.
Vermillion River, Huron River, Shinrock; infrequent.

H. CANADENSE, L.*
South-east of Milan; rare.

H. CANADENSE MAJUS, Gray.*
Perkins, Groton ; infrequent.

H. GYMNANTHUM, Engelm & Gray.*
Prairie, Oxford and Perkins; common.

H. KALMIANUM, L.
Prairie north and west of Castalia; common. Middle Bass; rare. "Put-in-Bay."

H. MACULATUM, Walt.
Frequent. Rattlesnake Island.

H. MUTILUM, L.
Frequent. Common on Oxford prairie.

H. *perforatum*, L. Common St. John's-wort.
Frequent. Common in parts of Berlin. Kelley's Island. Middle Bass.

H. SAROTHRA, Michx. (H. NUDICAULE Walt.)
Orange-grass. Pine-weed.
Oxford; common on the shale. Huron, Vermillion; local.

H. VIRGINICUM, L. (ELODES CAMPANULATA, Pursh.)
Marsh St Johns-wort.
Infrequent.

CISTACEÆ.

HELIANTHEMUM, Pers. Frost-weed.

H. CANADENSE, Michx.
Margaretta Ridge and Perkins; rare.

H. MAJUS, (L) B. S. P.
East of Milan; infrequent. Cedar Point and southern Perkins; local.

LECHEA, Kalm. Pinweed.

L. LEGGETTII, Britt & Holl.
Leonard's Hazel Patch, Perkins.

L. MAJOR, Michx.
Wintergreen woods east of Milan, Bloomingville cemetery, Castalia cemetery, Smith's, Perkins; local. "Cedar Point" Claassen.

L. MINOR, L. (L. THYMIFOLIA of Gray's Manual.)
Vermillion, southern Perkins and east of Milan; local and scarcer than the last.

VIOLACEÆ.

IONIDIUM, Vent.

I. CONCOLOR, Benth & Hook. Green Violet.
Vermillion River, Florence; rare.

VIOLA, L. Violet.

V. BLANDA, Willd. Sweet White Violet.
One wet field in Margaretta, since plowed up. "Perkins." "Berlin."

V. BLANDA PALUSTRIFORMIS, Gray.*
Damp cool rocks, Vermillion River and tributary ravines; scarce.

V. CANINA MUHLENBERGII, Gray. Dog Violet.
Vermillion River near Birmingham; one specimen. Also Rocky Ridge, Ottawa county.

V. CUCULLATA, Ait. Common Blue Violet.
Abundant. In bloom October 8.

V. LANCEOLATA, L. Lance-leaved Violet.
Oxford and Perkins prairie; rather frequent. Vermillion southeast of the village; locally plentiful.

V. OVATA, Nutt.*
Castalia cemetery; rare.

V. PALMATA, L.
Sandusky, Catawba; scarce.

V. PEDATIFIDA, G. Don.*
Marblehead; scarce. Margaretta and Perkins rare.

V. PUBESCENS, Ait. Downy Yellow Violet.
Common.

V. PUBESCENS SCABRIUSCULA, Torr & Gray.
Perkins, Milan. Apparently common: we have confounded it with the species.

V. ROSTRATA, Pursh. Long-spurred Violet.
Florence; frequent. Berlin Heights, but not nearer Sandusky.

V. SAGITTATA, Ait. Arrow-leaved Violet.
Prairie, Oxford and Perkins; common. East of Milan. Vermillion. In bloom October 5.

V. STRIATA, Ait. Pale Violet.
Common along rivers and, locally, elsewhere.

V. TENELLA, Muhl. (Viola *tricolor arvensis* DC., perhaps.) Field Pansy. Cedar Point, Johnson's Island, Marblehead, Catawba. Put-in-Bay; infrequent but apparently indigenous. V. *tricolor* L., Pansy, persists where it has been cultivated. Three other species grow in Cuyahoga county. See page 30.

CACTACEÆ.

OPUNTIA, Mill. Prickly Pear.

O. RAFINESQUII, Engelm.*
Cedar Point and one field in Margaretta; common. Marblehead; scarce.

THYMELÆACEÆ.

DIRCA, L. Leatherwood. Moosewood.

D. PALUSTRIS, L.
One bush on Beecher's flats, Vermillion River, southern Florence. "Formerly plentiful" there.

ELÆAGNACEÆ.

SHEPHERDIA, Nutt.

S. CANADENSIS, Nutt.
One spot on east fork Vermillion River; rare. "Cedar Point," W. A. Kellerman.

LYTHRACEÆ.

AMMANNIA, L.

A. COCCINEA, Rottb.*
Presque Isle Point, Peninsula; local.

LYTHRUM, L. Loosestrife.

L. ALATUM, Pursh.
Common, especially on wet prairies.
Put-in-Bay and Middle Bass the only Islands.

NESÆA, Comm, Juss.

N. VERTICILLATA, HBK. (DECODON VERTICILLATUS. Ell.) Swamp Loosestrife.
Marshes connected with Bay and Lake; common.
Islands.

ROTALA, L.

R. RAMOSIOR, Koehne.
Marblehead; rare. The only spot in northern Ohio.

MELASTOMACEÆ.

RHEXIA, L. Deer-Grass. Meadow-Beauty.

R. VIRGINICA, L.*
Southern Perkins and East of Milan; plentiful in a few places; regarded rare until 1898.

ONAGRACEÆ.

CIRCÆA, L. Enchanter's Nightshade.

C. ALPINA, L.
Florence, mostly on old logs; scarce.

C. LUTETIANA, L.
Common. Put-in-bay the only Island.

EPILOBIUM, L. Willow-herb.

E. ADENOCAULON, Haussk.
Castalia, Vermillion in old quarry, Marblehead, Kelley's Island, North Bass; infrequent.

E. ANGUSTIFOLIUM, L. Great Willow-herb. Fire-weed.
Infrequent.

E, COLORATUM. Muhl.
Frequent. Kelley's Island. Middle Bass.

E. LINEARE, Muhl.
Castalia and Peninsula; infrequent.

GAURA, L.

G. BIENNIS, L.
Rather frequent.

LUDWIGIA, L. False Loosestrife.

L. ALTERNIFOLIA, L. Seed-box.
Common on the shale. Cedar Point.

L. PALUSTRIS, Ell. Water Purslane.
Frequent.

L. POLYCARPA, Short & Peter.
Oxford, Perkins, Vermillion; infrequent.

ŒNOTHERA, L. Evening Primrose.

Œ. BIENNIS, L. Common Evening Primrose.
Common.

Œ. FRUTICOSA, L. Sundrops.
Kimball; locally plentiful.

Œ. OAKESIANA, Robbins.*
Sandusky and probably Cedar Point and elsewhere about the Lake. Not distinguished from Œ. *bennis* until 1898, probably for the reason that it is not annual, as described. Several years ago August Guenther, at my suggestion, pulled up a large number of Œnotheras on Cedar Point and elsewhere, but failed to find one with an annual root. One or the other species is very common on the shores of the Islands.

Œ. PUMILA, L.
Oxford, southern Perkins, east of Milan, Vermillion; scarce. "Southern Margaretta," Elsie Johns.

Œ. RHOMBIPETALA, Nutt.*
Cedar Point.

HALORAGIDACEÆ.

MYRIOPHYLLUM, L. Water-Milfoil.

M. SPICATUM, L.
Sandusky Bay, East Harbor, Catawba, Put-in-Bay; common.

PROSERPINACA, L. Mermaid-weed.

P. PALUSTRIS, L.
Perkins, Castalia, Marblehead; in swamps.

ARALIACEÆ.

ARALIA, L.

A. NUDICAULIS, L. Wild Sarsaparilla.
Rather frequent. Green Island, Kelley's Island.

A. QUINQUEFOLIA Decsne & Planch. Ginseng.
A few years ago frequent; now nearly exterminated. The ginseng dug on Put-in-Bay, 1892 and 1893, sold for about $800 at about $3 a pound.

A. RACEMOSA, L. Spikenard.
Frequent on steep banks of streams, and occurs in several other places.

A. TRIFOLIA, Decsne & Planch. Dwarf Ginseng. Ground-nut.
Two places in Florence.

UMBELLIFERÆ.

ARCHANGELICA, Hoffm.

A. ATROPURPUREA, Hoffm.
Castalia; frequent. Perkins.

A. HIRSUTA, Torr & Gray.
Sandy soil; infrequent.

CARUM, L. Caraway.

C. *carvi*, L.
Infrequent. Islands.

CHÆROPHYLLUM, L.

C. PROCUMBENS, Crantz.
Infrequent. Kelley's Island.

CICUTA, L. Water Hemlock.

C. BULBIFERA, L.
Frequent. Islands.

C. MACULATA, L. Musquash Root.
Frequent. Kelley's Island.

CONIUM, L. Poison Hemlock.

C. *maculatum*, L.
Roadside, Groton; local.

CRYPTOTÆNIA, DC. Honewort.

C. CANADENSIS, DC.
Frequent.

DAUCUS, L. Carrot.

D. *carota*, L.
A weed in some places in the eastern part of Erie county. Infrequent or scarce in Sandusky and elsewhere, but, perhaps, spreading from the east.

ERIGENIA, Nutt. Harbinger-of-Spring.

E. BULBOSA, Nutt.
Rather frequent near streams.
Kelley's Island.

ERYNGIUM, L.

E. YUCCÆFOLIUM, Michx.*
Rattlesnake-Master. Button Snake-root.
Southeast of Kimball; plentiful. Roadside west of Union Corners, and roadside at Joseph Smith's, Perkins; rare.

FŒNICULUM, Adans, Fennel.

F. *vulgare*, Mill. (F. *officinale*, All.)
Sandusky and Groton; rare.

HERACLEUM, L. Cow-Parsnip.

H. LANATUM, Michx.
Perkins, Florence, Port Clinton; infrequent.

HYDROCOTYLE, L. Water Pennywort.

H. AMERICANA, L.
Florence; rare.

OSMORRHIZA, Raf. Sweet Cicely.

O. BREVISTYLIS, DC.
Common.

O. LONGISTYLIS, DC.
Common.

PEUCEDANUM, L.

P. *sativum*, Benth & Hook. Parsnip.
Common. Kelley's the only island.

P. TERNATUM, Nutt. (TIEDEMANNIA RIGIDA, Coult & Rose.) Cowbane.
Infrequent.

PIMPINELLA, L.

P. INTEGERRIMA, Benth & Hook.
Frequent, especially on rocky hillsides. Kelley's Island, Put-in-Bay.

SANICULA, L. Sanicle. Black Snakeroot.

S. CANADENSIS, L.
Frequent or common. Put-in-Bay group.

S. MARYLANDICA, L.
Frequent or common. Kelley's Island.
The two species of sanicle are so much alike that I have not always attempted to distinguish between them. The U. S. National Museum has a specimen of *S. trifoliata* from Lorain county, and the same might probably be found in Erie county by diligent searching.

SIUM, L. Water Parsnip.

S. CICUTÆFOLIUM, Schrank.
Frequent. Kelley's Island.

THASPIUM, Nutt. Meadow-Parsnip.

T. AUREUM, Nutt.
Sandusky, Margaretta, Marblehead: infrequent. The so-called variety *atropurpureum* in Florence.

T. AUREUM TRIFOLIATUM. Coult & Rose.
Frequent on the Peninsula and in the western part of Erie county. Put-in-Bay.

T. BARBINODE, Nutt.
Margaretta, Peninsula, Islands; frequent. "Cedar Point."

T. BARBINODE, ANGUSTIFOLIUM, Coult & Rose.
Cedar Point, Johnson's Island, Marblehead, Mouse Island; frequent.

ZIZIA, Koch.

Z. AUREA. Koch.
Frequent. Kelley's Island.

CORNACEÆ.

CORNUS, L. Cornel. Dogwood.

C. ALTERNIFOLIA, L. f.
Florence, Catawba ; scarce.

C. AMOMUM, Mill. (C. SERICEA, L.)
Silky Cornel. Kinnikinnik.
Common.

C. ASPERIFOLIA, Michx.
Common.

C. CANDIDISSIMA, Mill. (C. PANICULATA, L'Her.)
Frequent.

C. CIRCINATA, L'Her. Round-leaved Cornel, or Dogwood.
Frequent, especially on the Peninsula and along the Vermillion River. Kelley's Island.

C. FLORIDA, L. Flowering Dogwood.
Common. Kelley's the only Island.

C. STOLONIFERA, Michx, Red-osier Dogwood.
Castalia; rare. Shore of Lake Erie east of Huron.

NYSSA, L. Tupelo.

N. MULTIFLORA, Wang. (N. SYLVATICA, Marsh.)
Pepperidge. Sour Gum.
Rich soil; infrequent.

PYROLACEÆ.

CHIMAPHILA, Pursh. Pipsissewa.

C. MACULATA, Pursh. Spotted Wintergreen.
Furnace woods, Vermillion.

C. UMBELLATA, Nutt. Prince's Pine.
Cedar Point; east of Milan; Vermillion River, Florence, rare.

PYROLA, L. Wintergreen.

P. ELLIPTICA, Nutt. Shin-leaf.
Florence, Milan, Perkins, Cedar Point, Marblehead; infrequent.

P. ROTUNDIFOLIA, L.
Florence, Berlin Heights, Milan, Perkins, Margaretta Ridge; infrequent.

MONOTROPACEÆ.

MONOTROPA, L. Indian Pipe.

M. UNIFLORA, L. Corpse-Plant.
Infrequent.

ERICACEÆ.

ARCTOSTAPHYLOS, Adans. Bearberry.

A. UVA-URSI, Spreng.*
Cedar Point; frequent. Vermillion River, Vermillion; rare.

EPIGÆA, L. Ground Laurel.

E. REPENS, L. Trailing Arbutus.
Berlin Heights; rare.

GAULTHERIA, L. Aromatic Wintergreen.

G. PROCUMBENS, L. Creeping Wintergreen.
One woods east of Milan; frequent. Berlin Heights and Vermillion River; rare. Formerly so plentiful on the banks of the Vermillion River north of Birmingham that they were known locally as the "Wintergreen Banks."

VACCINIACEÆ.

GAYLUSSACIA, H. B. K. Huckleberry.

H. RESINOSA, Torr & Gray. Black Huckleberry.
Oxford and east; frequent.

OXYCOCCUS, Hill. Cranberry.

O. MACROCARPUS, Pers. Large or American Cranberry.
Milan; nearly exterminated. "Formerly east of Berlin Heights and plentiful near Axtel."

VACCINIUM, L. Blueberry.

V. CORYMBOSUM, L. High-bush or Swamp Blueberry.
A few bushes on and near Tisdale's Vermillion, and in the old swamp near Axtel where years ago, "grew a thousand bushels of berries." See page 31.

V. PENNSYLVANICUM, Lam. Dwarf Blueberry.
Vermillion River, Vermillion; rare.

V. VACILLANS, Solander. Low Blueberry.
Frequent from the Huron River east. This and the Black Huckleberry are the only *Ericaceæ* often met with in Erie county and these not often west of the Huron River. I know of none of this order on the Islands and, excepting the Shin-leaf and "Indian Pipe," none on the Peninsula.

PRIMULACEÆ.

ANAGALLIS, L. Pimpernel.

A. *arvensis*, L. Common Pimpernel.
"Sandusky." Victor Hommel.

DODECATHEON, L. American Cowslip.

D. MEADIA, L.* Shooting-Star.
Castalia; rare. Called also Pride-of-Ohio, but probably not one in a thousand of the people now living in Ohio ever saw it growing wild.

LYSIMACHIA, L. Loosestrife.

L. *nummularia*, L. Moneywort.
Frequent in damp places along roads and occasional elsewhere. Middle Bass.

L. QUADRIFOLIA, L.
Rather frequent.

L. STRICTA, Ait.
Infrequent. Bass Islands.

L. THYRSIFLORA, L. Tufted Loosestrife.
Perkins, Huron, Cedar Point, Catawba; infrequent.

SAMOLUS, L. Water Pimpernel. Brook-weed.

S. VALERANDI AMERICANUS, Gray.
Florence, Shinrock, Huron, Milan, Groton; infrequent.

STEIRONEMA, Raf.

S. CILIATUM, Raf.
Common.

S. LONGIFOLIUM, Gray.
Sandusky, Oxford, Margaretta, Peninsula, Put-in Bay, Middle Bass, Rattlesnake Island; frequent.

OLEACEÆ.

FRAXINUS, L. Ash.

F. AMERICANA, L. White Ash.
Common. Wood used by the Sandusky Tool Company for hoe handles.

F. PUBESCENS, Lam. Red Ash.
Frequent. Islands. On Kelley's Island fruit 2¼ inches long and 5-12 inch wide.

F. QUADRANGULATA, Michx. Blue Ash.
Islands and Peninsula; frequent. Margaretta Ridge.

F. SAMBUCIFOLIA, Lam. Black Ash.
Infrequent. Islands.

F. VIRIDIS, Michx. f. Green Ash.
Cedar Point and Vermillion River.

LIGUSTRUM, L.

L. *vulgare*, L. Privet. Prim.
Cedar Point, Milan, etc; rare.

SYRINGA, L.

S. *vulgaris*, L. Lilac.
Kelley's Island; well established. Sandusky.

GENTIANACEÆ.

BARTONIA, Muhl.

B. TENELLA, Muhl.
East of Milan; rare.

FRASERA, Walt. American Columbo.

F. CAROLINENSIS, Walt.
Margaretta Ridge, Perkins, Huron, Berlin; scarce.

GENTIANA, L. Gentian.

G. ANDREWSII, Griseb. Closed Gentian.
Frequent along ditches.

G. CRINITA, Froel. Fringed Gentian.
Castalia, southern Perkins, eastern Milan, Oxford near Huron River; infrequent. "Marblehead."

G. DETONSA Rottb. (G. SERRATA, Gunner.)
Vermillion River, Florence; one young plant found on wet shale cliff.

G. PUBERULA, Michx.*
Southern Perkins; beautiful but very rare.

G. QUINQUEFLORA, Lam.
Vermillion River; frequent on the east fork. Margaretta Ridge; rare. The variety *occidentalis* in southern Perkins.

SABBATIA, Adans.

S. ANGULARIS, Pursh.
"Florence, 1888." Josephine Fish.
Eastern Milan and Vermillion River, Florence; scarce.

APOCYNACEÆ.

APOCYNUM, L.

A. ANDROSÆMIFOLIUM, L. Spreading Dogbane.
Frequent. Put-in-Bay. Middle Bass.

A. CANNABINUM, L. Indian Hemp.
Frequent but on lower ground. Islands.

VINCA, L.

V. *minor* L. Periwinkle, Myrtle.
Spreading in and from yards and cemeteries. Kelley's Island. Middle Bass.

ASCLEPIADACEÆ.

ACERATES, Ell. Green Milkweed.

A. LONGIFOLIA, Ell.*
Prairie; Oxford, Perkins, Huron; frequent.

A. VIRIDIFLORA, Ell.
Oxford, Margaretta, Cedar Point, Marblehead, Catawba. Infrequent, except on Marblehead, where the "variety" *lanceolata* also occurs.

ASCLEPIAS, L. Milkweed.

A. INCARNATA, L. Swamp Milkweed.
Common.

A. INCARNATA PULCHRA, Pers.
Castalia; rare.

A. OBTUSIFOLIA, Michx.*
In sand, Margaretta Ridge, Castalia cemetery, southern Perkins; rare.

A. PHYTOLACCOIDES, Pursh. Poke Milkweed.
In nine places, but scarce. Put-in-Bay.

A. PURPURASCENS, L. Purple Milkweed.
Perkins, Margaretta, Groton, Marblehead, Catawba; infrequent.

A. QUADRIFOLIA, Jacq.
Huron River and Perkins; rare.

A. SULLIVANTII, Engelm.*
Oxford and Sandusky; scarce.

A. SYRIACA, L. Common Milkweed or Silkweed.
Common.

A. TUBEROSA, L. Butterfly-weed. Pleurisy-root.
Frequent. Put-in-Bay. North Bass.

A. VERTICILLATA, L.
Southern Margaretta, Groton, Marblehead, Catawba; scarce.

CONVOLVULACEÆ.

CONVOLVULUS, L. Bindweed.

C. *arvensis*, L. Small Bindweed.
Sandusky and Islands; local.

C. SEPIUM, L. (CALYSTEGIA SEPIUM, R. Br.)
Hedge Bindweed.
Common. A rank weed in corn fields in Perkins. On portions of the bay shore of Cedar Point so thick as to make walking difficult.

C. SEPIUM REPENS, Gray.*
Oxford; frequent? Catawba. "Marblehead," U. G. Sanger.

IPOMŒA, L. Morning Glory.

I. PANDURATA, Meyer. (I. FASTIGIATA. Sweet.) Wild Potato-vine. Man-of-the-earth.
Frequent.

I. *purpurea*, Roth. Morning-glory.
Escaped into roads and waste places, Sandusky, Peninsula, Put-in-Bay, North Bass; infrequent.

CUSCUTACEÆ.

CUSCUTA, L. Dodder.

C. ARVENSIS, Beyrich.*
Oxford, Florence, Port Clinton; rare.

C. CHLOROCARPA, Engelm.*
Catawba; frequent. East Harbor, Castalia, Willow Point, Sandusky, Oxford; infrequent.

C. DECORA, Engelm.*
Marblehead; rare.

C. GRONOVII, Willd.
Common.

C. INFLEXA, Engelm.*
Oxford and Margaretta Ridge; scarce.

G. TENUIFLORA, Engelm.
Perkins, Oxford, Port Clinton, Put-in-Bay; Infrequent.

POLEMONIACEÆ.

PHLOX, L.

P. DIVARICATA, L.
Common. A specimen from Johnson's Island has narrow, acuminate, corolla lobes.

P. PANICULATA, L.
Spreading from gardens to roadsides in several places.

P. PILOSA, L.
Margaretta Ridge, Oxford, southern Perkins, Huron, Catawba; locally common.

P. SUBULATA, L. Ground or Moss Pink.
Catawba; frequent. Vermillion or Florence; rare. "Berlin" Sterling Hill.

POLEMONIUM, L. Greek Valerian.

P. REPTANS, L.
Near the Huron and Vermillion rivers; infrequent, "Hartshorn's, Peninsula." Pearl Green.

HYDROPHYLLACEÆ.

HYDROPHYLLUM, L. Waterleaf.

H. APPENDICULATUM, Michx.
Frequent, especially on the Islands and Peninsula.

H. CANADENSE, L.
Florence and Vermillion; rare.

H. MACROPHYLLUM, Nutt.
One spot on west bank of west fork of Vermillion River; a dozen or more plants growing with a few of the preceding species. Unknown elsewhere so far north.

H. VIRGINICUM, L.
Common. Islands, except Kelley's and Put-in-Bay.

PHACELIA, Juss.

P. PURSHII, Buckley.
Johnson's Island; common. Milan, Vermillion, Peninsula, Kelley's Island; scarce.

BORAGINACEÆ.

BORAGO, L.

B. *officinalis*, L. Borage.
Spontaneous near the Soldiers' Home.

CYNOGLOSSUM, L.

C. *officinale*, L. Hound's-tongue.
Common.

ECHINOSPERMUM, Lehm. Stickseed.

E. *lappula*, Lehm.
Peninsula, Kelley's Island, Middle Bass, Perkins, Sandusky; rather frequent.

E. VIRGINICUM, Lehm. Beggar's Lice.
Frequent. Kelley's Island. Put-in-Bay.

ECHIUM, L. Viper's Bugloss.

E. *vulgare*, L. Blue-weed.
Well established in the L. E. & W. freight yard, Sandusky.

LITHOSPERMUM, L.

L. *arvense*, L. Corn Gromwell.
Abundant One of the worst weeds on Kelley's Island and elsewhere.

L. CANESCENS, Lehm. Hoary Puccoon.
Peninsula, Margaretta, southern Perkins; infrequent.

L. HIRTUM, Lehm.* Hairy Puccoon.
Cedar Point; common.

MERTENSIA, Roth. Lungwort.

M. VIRGINICA, DC. Virginia Cowslip. Blue-bells.
Johnson's Island, Huron River; frequent. Marblehead, Kelley's Island, North Bass, Berlin, Vermillion River; infrequent or scarce.

MYOSOTIS, L. Scorpion-grass.

M. VERNA, Nutt.
Rather frequent. Put-in-Bay.

ONOSMODIUM, Michx.

O. CAROLINIANUM, DC.
Margaretta, western Perkins, Peninsula, Johnson's Island; infrequent.

VERBENACEÆ.

LIPPIA, L.

L. LANCEOLATA, Michx. Fog-fruit.
Sandusky, Margaretta, Groton, Johnson's Island, Peninsula, Put-in-Bay; infrequent.

VERBENA, L. Vervain.

V. ANGUSTIFOLIA, Michx.
Common in dry calcareous soil. Kelley's the only island.

V. BRACTEATA, Lag & Rodr.*
Near the L. E. & W. freight house; rare.

V. HASTATA, L. Blue Vervain.
Common.

V. URTICAEFOLIA, L. White Vervain.
Frequent. Islands. Hybrids between this and the preceding occur.

LABIATÆ.

BLEPHILIA, Raf.

B. CILIATA, Raf.
Johnson's Island, Marblehead, Catawba, Kelley's Island, Put-in-Bay, Margaretta, western Perkins; locally plentiful.

B. HIRSUTA, Benth.
In woods, Erie county and Catawba; infrequent.

CALAMINTHA. Lam.

C. CLINOPODIUM, Benth. Basil.
Islands, Peninsula, Cedar Point; common. Smith's woods, Perkins.

C. NUTTALLII, Benth.
Prairies, Castalia and Marblehead; common.

COLLINSONIA, L. Horse Balm.

C. CANADENSIS, L. Rich-weed.
Frequent.

HEDEOMA, Pers.

H. PULEGIOIDES, Pers. American Pennyroyal.
Common.

ISANTHUS, Michx.

I. CAERULEUS, Michx. False Pennyroyal.
Dry calcareous soil; frequent, especially about quarries. Kelley's Island. Common on Marblehead.

LAMIUM, L. Dead-Nettle.

I, *amplexicaule*, L.
Throughout but scarce. Islands.

L. *purpureum*, L.
"Soldiers' Home." Carl Anderson.

LEONURUS, L.

L. *cardiaca*, L. Motherwort.
Common.

LOPHANTHUS, Benth. Giant Hyssop.

L. NEPETOIDES, Benth.
Peninsula; frequent. Kelley's Island, Cedar Point, Johnson's Island, Groton, Perkins, Bloomingville, Florence; infrequent.

L. SCROPHULARIAEFOLIUS, Benth.
East of Milan; rare. Also at Oak Harbor, Ottawa county.

LYCOPUS, L. Water Hoarhound.

L. RUBELLUS, Moench.
Infrequent. Islands.

L. SINUATUS, Ell.
Frequent. Islands.

L. VIRGINICUS, L. Bugle-weed.
Common.

MARRUBIUM, L. Hoarhound.

M. *vulgare*, L. Common Hoarhound.
Islands and Peninsula; common. Margaretta Sandusky, Milan; local.

MELISSA, L. Balm.

M. *officinalis*, L. Common Balm.
Woods, Put-in-Bay and Vermillion; rare.

MENTHA, L. Mint.

M. CANADENSIS, L. Wild Mint.
Common.

M. *piperata*, L. Peppermint.
Frequent, especially about Castalia. "The continuous inhalation of the oil for several days will cure catarrh."

M. *viridis*, L. Spearmint.
Common. Put-in-Bay the only island.

M. CLINOPODIA, L.
Milan; rare.

M. FISTULOSA, L. Wild Bergamot.
Common. The variety *mollis* seems to be the more common form.

NEPETA, L. Cat-Mint,

N. *cataria*, L. Catnip.
Common.

N. *glechoma*, Benth. Ground Ivy. Gill.
Common. Not noticed on the Islands, except Rattlesnake, where it appeared about 1892, and Put-in-Bay. Along rivers it has become superabundant.

PHYSOSTEGIA, Benth., False Dragon-head.

P. VIRGINIANA, Benth.
Marblehead, Put-in-Bay, Middle Bass, Groton, eastern Sandusky; scarce.

PRUNELLA, L. Self-heal.

P. VULGARIS, L. Heal-all.
Common.

PYCNANTHEMUM, Michx. Mountain Mint.

P. LANCEOLATUM, Pursh.
Castalia; common. Oxford, Milan, Peninsula; frequent. Put-in-Bay.

P. LINIFOLIUM, Pursh.
Oxford prairie and Vermillion River flats; rare.

P. MUTICUM PILOSUM, Gray.
East of Port Clinton; rare.

SATUREIA, L. Savory.

S. *hortensis*, L. Summer Savory.
Well established in and near the village of Marblehead.

SCUTELLARIA, L. Skullcap.

S. GALERICULATA, L.
Common. Put-in-Bay and Middle Bass the only islands.

S. LATERIFLORA, L. Mad-dog Skullcap.
Common.

S. NERVOSA, Pursh.
Vermillion, woods east of the river and Florence along west fork; rare.

S. PARVULA, Michx.
Mostly in calcareous soil, Margaretta, Peninsula, Kelley's Island; frequent.

S. VERSICOLOR, Nutt.
Marblehead; frequent. Cedar Point, Johnson's Island, Put-in-Bay, Catawba, Margaretta, Perkins; infrequent.

STACHYS, L. Hedge-Nettle.

S. ASPERA, Michx.
Sandusky, Cedar Point, Peninsula; common. Middle Bass, North Bass.

S. TENUIFOLIA, Willd. (S. ASPERA GLABRA, Gray.)
Old Woman Creek, Berlin Heights; rare.

TEUCRIUM, L. Germander.

T. CANADENSE, L. Wood Sage.
Common especially on the shores of the Islands.

SOLANACEÆ.

DATURA, L. Jamestown or Jimson-weed.

D. *stramonium*, L.
Margaretta; frequent; elsewhere scarce.

D. *tatula*, L.
Frequent. Kelley's Island.

LYCIUM, L. Matrimony Vine.

L. *vulgare*, Dunal.
Escaped from gardens in some places. Kelley's Island.

LYCOPERSICUM, Hill.

L. *esculentum*, Mill. Tomato.
Sandusky; well established near the Bay. Kelley's Island. Put-in-Bay.

NICANDRA, Adans. Apple of Peru.

N. *physaloides*, Gaertn.
Perkins; scarce.

PHYSALIS, L. Ground Cherry.

P. HETEROPHYLLA, Nees. (P. VIRGINIANA, Gray.)
Common.

P. HETEROPHYLLA AMBIGUA, Gray.
Marblehead.

P. HETEROPHYLLA NYCTAGINEA, Dunal.
Huron, Milan, Perkins, Danbury.

P. LANCEOLATA, Michx.
Sandusky, Perkins, Port Clinton, Kelley's Island, "Marblehead."

P. PHILADELPHICA. Lam.
Perkins, Groton.

P. PRUINOSA, L.
Kelley's Island.

SOLANUM, L. Nightshade.

S. CAROLINENSE, L. Horse-Nettle.
Several places near railroads; scarce.

S. *dulcamara*, L. Bittersweet.
Frequent, especially on the Peninsula and Islands. Abundant in Lake woods east of Port Clinton. Appearing to be indigenous.

S. NIGRUM, L. Common Nightshade.
Common.

S. ROSTRATUM, Dunal.
Marblehead, about the quarry, where the dry soil seems adapted to this western weed, but we hope Mr. Harsh has succeeded in exterminating it. Put-in-Bay and "west of Sandusky," 1895.

SCROPHULARIACEÆ.

CASTILLEJA, L. Painted-Cup.

C. COCCINEA, Spreng. Scarlet Painted-Cup.
Hartshorn's, Peninsula and Catawba; rare.

CHELONE, L, Turtle-head.

C. GLABRA, L. Snake-head.
Throughout Erie county; infrequent.

CONOBEA, Aublet.

C. MULTIFIDA, Benth.*
Prairies, Castalia, Marblehead, Kelley's Island; scarce.

GERARDIA, L.

G. AURICULATA, Michx.*
Marblehead; rare.

G. FLAVA, L. Downy False Foxglove.
"Huron River?" Henry Schoepfle.

G. PURPUREA, L. Purple Gerardia.
Castalia, where it adorns the grounds of the Trout Club, Oxford, southern Perkins, Perrin's, Milan, Cedar Point, Peninsula; infrequent.

G. PURPUREA PAUPERCULA, Gray.*
Oxford and southern Perkins; rare.

G. QUERCIFOLIA, Pursh. Smooth False Foxglove.
Infrequent.

G. TENUIFOLIA, Vahl. Slender Gerardia.
Frequent. Kelley's Island.

GRATIOLA, L. Hedge-Hyssop.

G. SPHAEROCARPA, Ell.*
DeLamater's, Kimball; rare.

G. VIRGINIANA, L.
Rather frequent.

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V. [illegible]
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V. *thapsus*, L. Common Mullein.
Common.

VERONICA, L. Speedwell.

V. ANAGALLIS, L. Water Speedwell.
Margaretta, Huron, Berlin, Kelley's Island; infrequent.

V. *arvensis*, L. Corn Speedwell.
Common.

V. *hederæfolia*, L.* Ivy-leaved Speedwell.
"Yard on east Market St., Sandusky." Ione Pratt.

V. OFFICINALIS, L. Common Speedwell.
Margaretta Ridge and east of Port Clinton; rare. "Florence." Josephine Fish.

V. PEREGRINA, L. Neckweed. Purslane Speedwell.
Frequent. Put-in-Bay, North Bass, Rattlesnake Island.

V. SCUTELLATA, L. Marsh Speedwell.
Infrequent.

V. SERPYLLIFOLIA, L. Thyme-leaved Speedwell.
Frequent. Put-in-Bay.

V. VIRGINICA, L. Culver's-root. Culver's Physic.
Infrequent.

LENTIBULARIACEÆ.

UTRICULARIA, L. Bladderwort.

U. GIBBA, L.*
Cedar Point; local.

U. VULGARIS, L. Greater Bladderwort.
Sandusky Bay and East Harbor; frequent. Castalia; infrequent.

OROBANCHACEÆ.

APHYLLON, Mitchell.

A. UNIFLORUM, Gray. One-flowered Cancer-root.
Sandusky, three places; "Bogart" James D. Parker, Jr.; Florence; "Catawba" Earl Covell: scarce.

CONOPHOLIS, Wallroth. Squaw-root. Cancer-root.

C. AMERICANA, Wallroth.
Local. Put-in-Bay, northwest woods; plentiful. Perkins, big woods. Florence; two places.

EPIFAGUS, Nutt. Beech-drops. Cancer-root.

E. AMERICANUS, Nutt. (EPIPHEGUS VIRGINIANA, Bart). Florence, Vermillion, Berlin; frequent.

BIGNONIACEÆ.

TECOMA, Juss. Trumpet-flower.

T. RADICANS, Juss. Trumpet Creeper.
Frequent in woods and probably indigenous. Abundant on Cedar Point. Islands.

ACANTHACEÆ.

DIANTHERA, Gronov. Water-Willow.

D. AMERICANA, L.
Marblehead, Put-in-Bay, Middle Bass; rare. "Mills Creek; plentiful" Hommel.

PHRYMACEÆ.

PHRYMA, L. Lopseed.

P. LEPTOSTACHYA, L.
Frequent. Kelley's Island. Put-in-Bay.

PLANTAGINACEÆ.

PLANTAGO, L. Plantain.

P. ARISTATA, Michx.
Sandy field on Margaretta Ridge and near L. E. & W. freight house, Sandusky; rare.

P. CORDATA, Lam.
Huron and Florence; rare.

P. *lanceolata*, L. Ribgrass. Ribwort. English Plantain.
Frequent but not common in most parts. Kelly's Island, Put-in-Bay.

P. MAJOR, L. Common Plantain.
Common.

P. RUGELII, Decaisne.
More common than the preceding.

P. VIRGINICA, L.
Sandy field on Margaretta Ridge; rare.

RUBIACEÆ.

CEPHALANTHUS, L. Button-bush.

C. OCCIDENTALIS, L.
Common.

GALIUM, L. Bedstraw. Cleavers.

G. APARINE, L. Cleavers. Goose-Grass.
Abundant.

G. ASPRELLUM, Michx. Rough Bedstraw.
Infrequent. Islands.

G. BOREALE, L. Northern Bedstraw.
Perkins, Margaretta, Marblehead, Catawba, Kelley's Island; scarce.

G. CIRCÆZANS, Michx. Wild Liquorice.
Rather common. Put-in-Bay, Middle Bass, Rattlesnake Island.

G. CONCINNUM, Torr & Gray.
Common. Not on the Islands.

G. LANCEOLATUM, Torr. Wild Liquorice.
Florence, Vermillion, Berlin Heights; rare.

G. PILOSUM, Ait.
Frequent. One specimen shows a reversion of flowers to leaves.

G. TRIFIDUM, L. Small Bedstraw.
Frequent. Put-in-Bay. Middle Bass. The variety *pusillum* occurs at Castalia and "Cedar Point."

G. TRIFIDUM LATIFOLIUM, Torr.
Infrequent.

G. TRIFLORUM, Michx. Sweet-scented Bedstraw.
Frequent. Rattlesnake Island.

HOUSTONIA, L.

H. CÆRULEA, L. Bluets. Innocence.
Not found near Sandusky but in many places from southern Perkins south and east. East of Milan I have seen several million blossoms on three or four acres of ground, appearing at a distance as if a light snow had fallen, not completely covering the grass.

H. CILIOLATA, Torr.
Marblehead; common. Margaretta. Soldier's Home.

H. LONGIFOLIA, Gaertn.
Rocky shores of Rattlesnake Island and Put-in-Bay; frequent. Marblehead.

MITCHELLA, L. Partridge-berry.

M. REPENS, L.
Banks of Vermillion River and tributaries; common. Old Woman Creek at Berlin Heights; frequent. Milan, Perkins, Groton; scarce.

CAPRIFOLIACEÆ.

LONICERA, L. Honeysuckle.

L. GLAUCA, Hill.
Margaretta Ridge; rare.

L. GLAUCESCENS, Rydb.
Infrequent. Islands.

L. SEMPERVIRENS, L. Trumpet or Coral Honeysuckle.
Woods near Huron, where the seed was doubtless dropped by birds; rare.

SAMBUCUS. L. Elder.

S. CANADENSIS, L. Common Elder.
Common.

S. RACEMOSA, L. Red-berried Elder.
Eastern Sandusky; east of Milan; Vermillion River, Florence; scarce.

SYMPHORICARPOS, Juss. Snowberry.

S. ORBICULATUS, Moench. (S. VULGARIS, Michx.) Indian Currant. Coral-berry.
Sandusky and Milan; escaped.

S. RACEMOSUS, Michx. Snowberry.
Marblehead; common. Elsewhere scarce.

S. RACEMOSUS PAUCIFLORUS, Robbins.
Cedar Point; common.

TRIOSTEUM, L. Horse-Gentian.

T. PERFOLIATUM, L. Fever-wort.
Frequent.

VIBURNUM, L. Arrow-wood.

V. ACERIFOLIUM, L. Dockmackie.
Frequent from the Huron River east. Put-in-Bay.

V. DENTATUM, L.
Florence and eastern Berlin; infrequent.

V. LENTAGO, L. Sweet Viburnum. Sheep-berry.
Infrequent. Kelley's Island, Middle Bass.

V. OPULUS, L. Cranberry-tree.
"Groton" and big woods, Perkins; rare.

V. PUBESCENS, Pursh.
Marblehead, Catawba, Kelley's Island, Put-in-Bay; frequent.

VALERIANACEÆ.

VALERIANA, L. Valerian.

V. PAUCIFLORA, Michx.
Lake woods east of Port Clinton, Florence, Milan; rare.

VALERIANELLA, Poll. Corn-Salad. Lamb-Lettuce.

V. *olitoria*, Poll. *
Shinrock; rare.

V. RADIATA, Dufr.
Perkins, Milan, Shinrock; scarce.

V. WOODSIANA, Walp.*
Woodbury's woods, Berlin; local.

DIPSACACEÆ.

DIPSACUS, L. Teasel.

D. *sylvestris*, Mill.
Common. Kelley's the only island.

CUCURBITACEÆ.

ECHINOCYSTIS, Torr & Gray. Wild Balsam-apple.

E. LOBATA, Torr & Gray.
Lake woods east of Port Clinton; abundant. Elsewhere infrequent.

SICYOS, L.

S. ANGULATUS, L. One-seeded Bur-Cucumber.
Green Island; common. Rattlesnake Island, Put-in-Bay, Catawba, Port Clinton, Cedar Point, Sandusky; infrequent.

CAMPANULACEÆ.

CAMPANULA, L. Bellflower.

C. AMERICANA, L. Tall Bellflower.
Common.

C. APARINOIDES, Pursh. Marsh Bellflower.
Cedar Point, Venice, Peninsula; locally common.

C. ROTUNDIFOLIA. Harebell.
Common on rocky shores but apparently absent from Kelley's Island.

LOBELIA, L.

L. CARDINALIS, L. Cardinal-flower.
Infrequent. Islands.

L. INFLATA, L. Indian Tobacco.
Rather frequent. Put-in-Bay.

L. KALMII, L.
Common on rocky shores. Florence; rare.

L. SPICATA, Lam.
Common on the prairies.

L. SYPHILITICA, L. Great Lobelia.
Common. Kelley's, Middle Bass and North Bass the only islands.

SPECULARIA, Heister. Venus's Looking-glass.

S. PERFOLIATA, A. DC.
Infrequent. Kelley's Island, Put-in-Bay.

CICHORIACEÆ.

CICHORIUM, L. Chicory. Succory.

C. *intybus*, L.
Roadsides in a number of places; local. Common at Port Clinton and Catawba. Kelley's Island, Middle Bass.

HIERACIUM, L. Hawkweed.

H. CANADENSE, Michx.*
Huron, Milan, Oxford, Marblehead, Catawba; infrequent.

H. GRONOVII, L. Hairy Hawkweed.
Infrequent. The "variety" *subnudum* in the Bloomingville cemetery.

H. PANICULATUM, L.
Vermillion River and Berlin Heights; infrequent.

H. SCABRUM, Michx.
Frequent.

KRIGIA, Schreb. Dwarf Dandelion.

K. AMPLEXICAULIS, Nutt.
Frequent in Milan Township. Elsewhere infrequent. Kelley's Island.

LACTUCA, L. Lettuce.

L. ACUMINATA, Spreng.
Perkin's, Margaretta, Port Clinton; infrequent.

L. ALPINA, Benth & Hook, (L. LEUCOPHÆA, Gray.)
Frequent. Kelley's Island, Put-in-Bay.

L. CANADENSIS, L. Wild Lettuce.
Common.

L. FLORIDANA, Gaertn.
Margaretta Ridge, Cedar Point, Peninsula, Put-in-Bay, Green Island; frequent.

L. *scariola*, L. Prickly Lettuce.
Abundant. One of the worst weeds.

PRENANTHES, L. Rattlesnake-root.

P. ALBA, L. White-lettuce.
Common.

P. ALTISSIMA, L.
Infrequent. Put-in-Bay.

P. ASPERA, Michx.*
Prairie east of Kimball; rare.

P. CREPIDINEA, Michx.
Near Pipe Creek in German Settlement woods; rare.

P. RACEMOSA, Michx.
Prairies. West of Castalia; frequent. Oxford, Groton, "Perkins," "Gypsum"; infrequent or scarce.

SONCHUS, L. Sow-Thistle.

S. *asper*, Vill. Spiny-leaved Sow-thistle.
Infrequent. Islands.

S. *oleraceus*, L. Common Sow-Thistle.
Frequent. Islands.

TARAXICUM, L. Dandelion.

T. *officinale*, Weber. Common Dandelion.
Abundant. "In blossom when the boys were skating" Freyensee.

TRAGOPOGON, Goats-beard.

T. *porrifolius*, L. Salsify. Oyster-plant.
Roadsides; infrequent. Islands.

T. pratensis, L. Goats-beard.
Sandusky, in vacant lots near Central Avenue and elsewhere; spreading.

COMPOSITAE.

ACHILLEA, L. Yarrow.

A. MILLEFOLIUM, L. Common Yarrow or Milfoil.
Abundant.

ACTINELLA, Nutt.

A. ACAULIS GLABRA, Gray.*
Marblehead prairie; infrequent but occurring at places widely separated and, apparently, indigenous.

ACTINOMERIS, Nutt.

A. SQUARROSA, Nutt.
Frequent on flood grounds of streams.

AMBROSIA, L. Ragweed.

A. ARTEMISIÆFOLIA, L. Ragweed. Roman Wormwood.
Abundant. After *Setaria glauca* probably the worst weed.

A. TRIFIDA, L. Great Ragweed.
Common. The so-called variety *integrifolia* is infrequent.

ANTENNARIA, Gaertn. Everlasting.

A. PLANTAGINEA, R. Br. Plantain-leaved Everlasting.
Common. Kelley's and Put-in-Bay the only islands. A specimen collected on Marblehead by Ralph H. McKelvey is what Greene would call *A. neglecta* and one in Perkins by Will Sprow *A. neodioica.*

ANTHEMIS, L. Chamomile.

A. *cotula*, L. May-weed.
Common.

ARCTIUM, L. Burdock.

A. *lappa majus*, Gray.
"Bogart" H. D. Banks.

A. *lappa minus*, Gray.
Common.

ARTEMISIA, L. Wormwood.

A. *annua*, L.
Sandusky, well established near the Big Four docks.

A. BIENNIS, Willd.
Sandusky, Castalia, Johnson's Island, Marblehead, Middle Bass, North Bass; frequent only near railroads or docks.

A. CAUDATA, Michx.*
Cedar Point and Marblehead sand spit; common.

A. LUDOVICIANA, Nutt.* Western Mugwort.
Established in one spot on embankment of L. S. & M. S. Ry., eastern Sandusky.

A. *vulgaris*, L. Common Mugwort.
Escaped in cemeteries and from gardens to roads; scarce.

ASTER, L.

A. AZUREUS, Lindl.
Sandy soil from Margaretta Ridge to Berlinville; infrequent. Catawba.

A. CORDIFOLIUS, L.
Frequent.

A. CORYMBOSUS, Ait.
Florence and Milan; scarce.

A. DIFFUSUS, Ait.
Frequent and variable.

A. DUMOSUS, L.*
Sandy soil, Milan, southern Perkins; infrequent. Oxford; frequent? Flowers white.

A. ERICOIDES, L.
Common on rocky shores.

A. ERICOIDES PLATYPHYLLUS, Torr & Gray.*
Castalia; rare.

A. JUNCEUS, Ait.*
Castalia and east of Milan; scarce.

A. LAEVIS, L.
Milan, Huron, Oxford, Margaretta, Florence, Catawba; rather frequent.

A. MACROPHYLLUS, L.
Frequent but not observed near Sandusky. Put-in-Bay.

A. MULTIFLORUS, Ait.
Dry soil in the limestone region; frequent. Put-in-Bay.

A. NOVÆ-ANGLIÆ, L.
Along roads near Sandusky and south next to the most common Aster. Not so common in the eastern part of the county and on the Peninsula. Kelley's Island, Put-in-Bay; scarce.

A. PANICULATUS, Lam.
Our most common Aster.

A. POLYPHYLLUS, Willd.
Marblehead, Put-in-Bay, Gibraltar, and probably other islands.

A. PRENANTHOIDES, Muhl.
Perkins, Bloomingville, Milan, Berlin, Florence; infrequent.

A. PTARMICOIDES, Torr & Gray.*
Marblehead; local.

A. PUNICEUS, L.
Castalia, Bloomingville, Milan, Florence; infrequent.

A. PUNICEUS LUCIDULUS, Gray.*
Castalia, along the mill race.

A. SAGITTIFOLIUS, Willd.
Common.

A. SALICIFOLIUS, Ait.
Oxford, Milan, Groton, Margaretta, Sandusky, Catawba; infrequent. Many specimens of A. *paniculatus* approach this species.

A. SHORTII, Hook.
Peninsula and Islands; common. Huron and Vermillion Rivers; frequent.

A. TRADESCANTI, L.
Frequent, at least in Perkins and Oxford. Kelley's Island.

A. UMBELLATUS, Mill.
Infrequent.

A. VIMINEUS, Lam.*
Perkins and probably elsewhere.

BIDENS, L. Bur-Marigold.

B. BECKII, Torr.* Water Marigold.
Black Channel, Biemiller's Cove, East Harbor; scarce.

B. BIPINNATA, L. Spanish Needles.
Sandusky, Cedar Point, Catawba, North Bass; rare.

B. CERNUA, L. Smaller Bur-Marigold.
Perkins and Margaretta; scarce.

B. CHRYSANTHEMOIDES, Michx. Larger Bur-Marigold.
Frequeut. Islands.

B. CONNATA, Muhl. Swamp Beggar-ticks.
Common. One specimen seven feet tall. Some specimens have the awns upwardly barbed.

B. CONNATA COMOSA, Gray.
Frequent.

B. FRONDOSA, L. Common Beggar-ticks. Stick-tight.
Common. A troublesome weed.

BOLTONIA, L'Her.

B. ASTEROIDES, L'Her.
Sheltered beaches of Lake Erie and Sandusky Bay especially Johnson's Island and the beach stretching from Port Clinton towards Catawba. Not on rocks nor pure sand. Put-in-Bay the only island in the lake.

CALENDULA, L. Marigold.

C. *officinalis*, L. Garden Marigold.
Sandusky and Put-in-Bay; spreading and escaping, but seldom far from gardens. Hardly naturalized.

CENTAUREA, L.

C. *cyanus*, L. Blue-bottle. Corn-flower.
Kelley's Island and elsewhere; sparingly escaped.

CHRYSANTHEMUM, L.

C. *balsamita*, L. Costmary.
Escaped from gardens in several places.

C. *leucanthemum*, L. Ox-eye or White Daisy. White-weed.
Common in several places but not generally distributed. Put-in-Bay.

C. *parthenium*, Bernh. Feverfew.
Escaped to waste places in Sandusky and well established in woods on Put-in-Bay.

CNICUS, L.

C. ALTISSIMUS, Willd.
Infrequent. Kelley's Island.

C. *arvensis*, Hoffm. Canada Thistle.
Frequent, especially near the Lake and Bay. Islands.

C. DISCOLOR, Muhl.
Frequent.

C. *lanceolatus*, Willd. Common Thistle.
Common.

C. MUTICUS, Ell. Swamp Thistle.
Infrequent.

COREOPSIS, L. Tickseed.

C. ARISTOSA, Michx.
Castalia and Venice marshes; common. Cedar Point, Catawba, Vermillion; frequent.

C. DISCOIDEA, Torr & Gray.
Sandusky, Cedar Point, Oxford; locally plentiful.

C. TRICHOSPERMA. Michx. Tickseed Sunflower.
Infrequent.

C. TRICHOSPERMA TENUILOBA, Gray.
Frequent, especially on wet prairies. Kelley's Island. Hundreds of acres of marsh near Bay Bridge glow in autumn with the yellow blossoms, a sight worth going far to see.

C. TRIPTERIS, L. Tall Coreopsis.
Frequent from Milan and Cedar Point west. Peninsula.

ECLIPTA, L.

E. ERECTA, L. (E. ALBA Hassk.)
Sandusky, East Harbor, Lockwood's; scarce.

ERECHTITES, Raf. Fireweed.

E. PRÆALTA, Raf. (E. HIERACIFOLIA, Raf.)
Common.

ERIGERON, L. Fleabane.

E. ANNUUS, Pers. Daisy Fleabane. Sweet Scabious.
Common.

F. BELLIDIFOLIUS, Muhl. Robin's Plantain.
Milan, Perkins, Margaretta Ridge; infrequent.

E. CANADENSIS, L. Horse-weed. Butter-weed.
Common.

E. PHILADELPHICUS, L. Common Fleabane.
Common.

E. STRIGOSUS, Muhl. Daisy Fleabane.
Frequent or common. Islands. Abundant on Marblehead.

EUPATORIUM, L. Thoroughwort.

E. AGERATOIDES, L. White Snakeroot.
Common. Rattlesnake the only island. This plant H. H. Lockwood says is the "Trembleweed" and the cause of milk sickness.

E. ALTISSIMUM, L.
Northwestern Margaretta; infrequent. Johnson's, Marblehead; rare.

E. PERFOLIATUM, L. Thoroughwort. Boneset.
Common.

F. PURPUREUM, L. Joe-Pye Weed. Trumpet-Weed.
Common. Not on the Islands.

E. SESSILIFOLIUM, L. Upland Boneset.
Milan, Huron, Catawba; rare.

GNAPHALIUM, L. Cudweed.

G. DECURRENS, Ives. Everlasting.
Catawba and Florence; very rare.

G. OBTUSIFOLIUM, L. (G. POLYCEPHALUM, Michx.) Common Everlasting.
Common.

G. PURPUREUM, L. Purplish Cudweed.
Infrequent.

G. ULIGINOSUM, L. Low Cudweed.
Infrequent.

HELENIUM, L. Sneeze-weed.

H. AUTUMNALE, L.
Common at Sandusky and vicinity. Florence. Catawba.

HELIANTHUS, L. Sunflower.

H. ANNUUS, L.
Frequently escaped. "Cedar Point, far from any house" Ralph H. McKelvey.

H. DECAPETALUS, L.
Frequent.

H. DIVARICATUS, L.
Frequent, especially on Marblehead and the Islands.

H. GIGANTEUS, L.
Sandusky to Milan and west; common. The so-called variety, *ambiguus*, occurs in Perkins and Oxford, and near Port Clinton.

H. GROSSE-SERRATUS, Martens.
Oxford, Groton, Margaretta; frequent.

H. HIRSUTUS, Raf.
Cedar Point, Peninsula, Oxford, Margaretta, Groton; rather common.

H. MOLLIS, Lam.*
Prairie, Oxford and Huron; enough to supply the botanists of the world.

H. OCCIDENTALIS, Riddell.
Castalia cemetery and Kimball; scarce.

H. PARVIFLORUS, Bernh.
Frequent.

H. STRUMOSUS MOLLIS, Torr & Gray.*
Oxford, Groton, Castalia, Cedar Point, Port Clinton; infrequent. Apparently all our specimens of *H. strumosus* are of this variety.

H. TRACHELIIFOLIUS, Willd.
Florence, Port Clinton; scarce?

H. TUBEROSUS, L. Jerusalem Artichoke.
Frequent. Kelley's Island. Put-in-Bay.

HELIOPSIS, Pers. Ox-eye.

H. LÆVIS, Pers.
Common.

H. SCABRA, Dunal.
Rather frequent.

INULA, L. Elecampane.

I. *helenium*, L.
Infrequent. Florence; frequent.

KUHNIA, L.

K. EUPATORIOIDES, L.
Dry soil near Castalia; locally common. Sandusky and Perkins; scarce.

LEPACHYS, Raf.

L. PINNATIFIDA, Raf.
Common on prairies.

LIATRIS, Schreb. Button Snakeroot.

L. SCARIOSA, Willd.
Catawba, Cedar Point, Margaretta Ridge, southern Perkins, Kimball; plentiful in some places.

L. SPICATA, Willd.
Castalia prairie; abundant and showy. Marblehead, Cedar Point, Oxford, southern Perkins, Groton, east of Milan; frequent on undisturbed damp ground.

L. SQUARROSA INTERMEDIA, DC.* Blazing-Star.
Castalia and Sandhill cemeteries.

POLYMNIA, L. Leaf-Cup.

P. CANADENSIS, L.
Cedar Point, Peninsula, Islands; infrequent.

RUDBECKIA, L. Cone-flower.

R. HIRTA, L.
Common. Not on the Islands.

R. LACINIATA, L.
Frequent.

R. TRILOBA, L.
"Port Clinton" Wm. Krebs.

SENECIO, L. Groundsel.

S. ATRIPLICIFOLIUS, Hook. (CACALIA ATRIPLICIFOLIA, L.) Pale Indian Plantain.
Vermillion River, Florence; frequent. Elsewhere infrequent.

S. AUREUS, L. Golden Ragwort.
Frequent.

S. AUREUS OBOVATUS, Torr & Gray. Squaw-weed.
Common. Kelley's the only island.

S. AUREUS BALSAMITÆ, Torr & Gray.
Castalia, Perkins, Marblehead, Catawba; frequent. Put-in-Bay.

SILPHIUM, L. Rosin-weed.

S. PERFOLIATUM, L. Cup-Plant.
Huron and Vermillion rivers; infrequent. Castalia; local.

S. TEREBINTHENACEUM, Jacq. Prairie Dock.
Common on the prairies.

S. TRIFOLIATUM, L.
Frequent.

SOLIDAGO, L. Golden-rod.

S. BICOLOR, L.
Frequent.

S. BICOLOR CONCOLOR, Torr & Gray.
Rocky shores of the Put-in-Bay Islands; infrequent.

S. CAESIA, L.
Common in rich woods. Islands.

S. CANADENSIS, L.
Abundant.

S. JUNCEA, Ait.
Frequent.

S. LANCEOLATA, L.
Common.

S. LATIFOLIA, L.
Florence; frequent. Vermillion, Berlin Heights, Milan, Perkins, Catawba, Kelley's Island, Green Island, Rattlesnake; scarce.

S. NEMORALIS, Ait.
Frequent. Islands.

S. OHIOENSIS, Riddell.
Castalia prairie; infrequent.

S. PATULA, Muhl.
Florence, Milan, Castalia, Kelley's Island; infrequent.

S. RIDDELLII, Frank.
Castalia; frequent. Marblehead, Groton, House's swamp, Perkins; infrequent.

S. RIGIDA, L.
Marblehead and Oxford; frequent. Huron, Sandusky, Margaretta, Groton, Middle Bass; local.

S. RUGOSA, Mill.
East of Milan; local.

S. SEROTINA, Ait.
Frequent.

S. SEROTINA GIGANTEA, Gray.
Milan, Oxford, southern Perkins; scarce.

S. SPECIOSA, Nutt.
Huron River and Peninsula; infrequent. Southern Pèrkins; scarce.

S. SPECIOSA ANGUSTATA, Torr & Gray.*
Leonard's Hazel Patch, Perkins; rare.

S. TENUIFOLIA, Pursh.
Oxford prairie; abundant.

S. ULMIFOLIA, Muhl.
Marblehead; frequent. Elsewhere infrequent. Islands.

TANACETUM, L. Tansy.

T. *vulgare*, L.
Roadsides; frequent. Islands. The ordinary form is the variety *crispum*, but the other occurs in "Perkins" and on "Kelley's Island."

VERNONIA, Schreb. Iron-weed.

V. ALTISSIMA, Nutt.
Common. Kelley's the only island.

V. ALTISSIMA GRANDIFLORA, Nutt.
Huron, Willow Point, Kelley's Island; infrequent.

V. FASCICULATA, Michx.
Prairies; frequent.

XANTHIUM, L. Cocklebur.

X. CANADENSE, Mill.
Common. The so-called variety *echinatum* is the common form near the Bay and Lake.

CORRECTIONS.

Page 7. For Hypericum kalmianum read *Potentilla fruticosa*. The two grow together on the prairie but the latter is more abundant and to it belong the small petrified leaves collected.

Page 28. The four names at the top of first column should be at the bottom.

Page 50. For P. *annual* read P. *annua*.

Page 54. For *hedunculata* read *pedunculata*.

Page 63. For J. TENVIS read J. TENUIS.

Page 76. Place a mark of doubt —?— after occurs, at end of third line.

Page 84. For **AMONACEÆ** read **ANONACEÆ**.

Page 94. For **SAXIFRAGACÆ** read **SAXIFRAGACEÆ**.

Page 150. For T. pratensis read T. *pratensis*.

INDEX.

*** The names of families are in capitals. In the catalogue the genera of each family and the species of each genus are arranged alphabetically.

Ohio State Academy of Science.

SPECIAL PAPERS NO. 2.

THE ODONATA OF OHIO.

A DESCRIPTIVE CATALOGUE OF THE DRAGONFLIES KNOWN IN OHIO, WITH KEYS FOR THEIR DETERMINATION.

A POSTHUMOUS PAPER

BY

DAVID S. KELLICOTT, PH. D.,

LATE PROFESSOR OF ZOOLOGY AND ENTOMOLOGY IN THE OHIO STATE UNIVERSITY.

PUBLISHED BY THE ACADEMY OF SCIENCE,
MARCH, 1899.

PRESS OF CLAPPER PRINTING CO.
WOOSTER, OHIO.

PREFATORY NOTE

The paper on the *Odonata* of Ohio, by Prof. D. S. Kellicott herewith presented to the public, was in such an advanced stage of progress at the time of his death that there can be no possible question as to the desirability of publishing it in the form which he had given to it. It was necessary, however, in order to give it the completeness that would make it most serviceable in the line intended by the author that the species not covered in the manuscript he left should be given a similar treatment. This duty has been performed by Mr. J. S. Hine, whose long association with Prof. Kellicott, and participation with him in the collection and preparation of material on which the paper is based gave him exceptional advantages for the work. Of the original manuscript by Prof. Kellicott, which covers everything up to and including *Gomphus externus* nothing has been changed, except to make such verbal changes as he himself would have made on a final revision for the press. For the remainder the effort has been to complete as nearly as possible on the plan followed by Prof. Kellicott, in the portion he had finished and, wherever possible, use has been made of his published descriptions.

The sketch of Prof. Kellicott's life, and the bibliography have also been prepared by Mr. Hine, the drawings for the plates by Mr. W. E. Kellicott.

HERBERT OSBORN.

Dept. Zool. and Ent. O. S. U., Columbus, Ohio.

Feb. 10, 1899.

BIOGRAPHICAL SKETCH.

David S. Kellicott, Ph. D., late Professor of Zoology and Entomology at the Ohio State University, was born at Hasting's Center, Oswego County, New York, January 28, 1842. His boyhood days were spent on a farm, where early in life he acquired an intense love for nature.

He availed himself of the opportunities for preliminary education offered by the district school, and prepared for College at Mexico Academy, Mexico, New York. He entered Genesee College, now Syracuse University, and completed the science course. Later he received the degrees of Bachelor of Philosophy, and Doctor of Philosophy from the same Institution. His life work was teaching; he taught village schools at first, but was soon called to college work, and from 1870–'72 was teacher of Mathematics in the Keystone State Normal School. At this time an opportunity presented, and he accepted a position in his chosen field, becoming Professor of Natural History in the Buffalo State Normal School, which position he held until he resigned in 1888, to accept the position at the Ohio State University. Here his quiet enthusiasm, indomitable energy and enlightened judgment developed his department to a high degree of efficiency.

The scientific attainments of Professor Kellicott have been gratefully recognized by an appreciative public. At the time of his death he was president of the American Microscopical Society, General Secretary of the American Association for the Advancement of Science, and Treasurer of the Ohio State Academy of

Science. Formerly he was president of the Buffalo Academy of Science, and the Ohio State Academy of Science. He was among the first in this country to become a fellow of the Royal Microscopical Society of London.

His death was caused by pneumonia. After an illness of only a few days he died April 13th 1898.

Professor Kellicott has contributed articles to various American periodicals, most of which are included in the following list.

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS.

1879. On Certain Crustaceous Parasites of Fishes from the Great Lakes. I, 53.
Observations on *Lerneocera cruciata*. I, 64.
1880. *Lerneocera tortura*, n. s. II, 41.
1882. On Certain Crustaceous Parasites of Fresh-Water Fishes. IV, 75.
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1883. On some Infusoria found on the Cray-Fish. V, 105.
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1884. Observations on Infusoria with Description of New Species. VI, 110.
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1885. Observations on some Fresh-water Infusoria—with Descriptions of a few Species regarded as new. 38.
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1886. A note on Argulus catostomi. 144.
1887. Additional note on a Certain Species of Rotifera. 181.
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1888. President's Address: The Nature of Protozoa, and Lessons of these Simplest Animals. 5.
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1892. Crustaceous Parasite of the "Miller's Thumb." 76.
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1896. The Rotifera of Sandusky Bay—First Paper. 155.
1897. The Rotifera of Sandusky Bay—Second Paper. 43.

Annual Report of the Ohio State Academy of Science.

1893. On Certain Marine Infusoria observed at Woods Hall, Mass. II, 10.
Preliminary Report of the Dragonflies of Ohio. II, 11.
1895. Third Report on the Odonata of Ohio. IV, 33.
1896. Additions to the Catalogue of the Odonata of Ohio. V, 47.
Preliminary Report on the Fresh-Water Sponges of Ohio. V, 50.
1897. Additions to the Catalogue of Dragonflies of Ohio. VI, 27.

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1891. The Preparatory Stages of Eustrotia caduca. III, 321.
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Notes on the Aegeriidæ of Central Ohio–II. V, 81.

Journal of the Cincinnati Society of Natural History.

1893. Remarkable Malformation in a Cat. XV, 54.
1895. Catalogue of Ohio Odonota-Part I. XVII, 195.
1896. Catalogue of Ohio Odonata-Part II. XVIII, 105.
1897. Catalogue of Ohio Odonata–Part III. XIX, 66.
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1885. On the Larval Stages of Harmonia pini, and a Parasite of the same. I, 171.
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Entomological News.

1890. Dragonflies Congregating at Night. I, 146.
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TRANSACTIONS OF THE OHIO STATE MEDICAL SOCIETY.

Certain Entozoa of the Dog and Sheep. 1894.
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JOURNAL OF THE COLUMBUS HORTICULTURAL SOCIETY.

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1896. Remarkable Extension in the Northward Range of the Bag or Basket Worm. XI, 4.
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1885. Opercularia constricta, n. s.
1888. Nature of Protozoa.

NATURALISTS BULLETIN.

1883. The Larvæ of the Catocalæ.

51ST ANNUAL REPORT OF BUFFALO LIBRARY.

Address at the Opening of the Buffalo Public Library.

BULLETIN OF THE BUFFALO NATURALIST'S AND FIELD CLUB.

1883. Notes on Protozoa. No. I.
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BULLETIN OF THE BUFFALO SOCIETY OF NATURAL SCIENCE.

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The Microscope.

1887. Notes on Fresh Water Infusoria, with Remarks on Collecting and Preserving these Delicate Animals.
1889. Intestinal Parasitic Infusoria of the Frog.

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1882. Is Poedisca Scudderiana a Gall-maker? XIV, 161.
1883. Psephenus Lecontei—On the External Anatomy of the Larva. XV, 191.
1884. A Note—Ovipositing Apparatus of Nonagria Subcarnea. XVI, 170.
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1885. Eumacaria brumearia, Packard. XVII, 32.
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Yours truly,
D. S. Kellicott.

TO MY ASSOCIATES AND STUDENTS
IN THE
DEPARTMENT OF ZOOLOGY
OF THE
OHIO STATE UNIVERSITY, THIS BOOKLET IS DEDICATED,
IN MEMORY OF
HAPPY HOURS SPENT TOGETHER
AS NATURALISTS IN FIELDS AND WOODS.

INTRODUCTION.

This brochure has been prepared in answer to the often repeated query of students and young naturalists, "What book can I get to help me in identifying the dragonflies." If it does not prove helpful to these inquiring ones, the purpose of its making has been missed. The effort has been to prepare a helpful and suggestive guide, clear and scientifically accurate; and to record without too painful dryness, the present state of our knowledge of a delightful group of insects. Should the attempt prove in a measure successful, as a means of increasing interest in these lively creatures and in helping some earnest minded young people to enjoy more thoroughly the pleasures of studying nature afield, the writer will feel richly repaid for his pains.

The writings of Dr. Herman Hagen, Baron de Selys-Longchamps, W. F. Kirby, Benjamin D. Walsh Philip P. Calvert, Nathan Banks, Rene′ Martin and other students of the odonata have been freely consulted and deep obligations to each are acknowledged. Much assistance has been given in collecting by Professor J. S. Hine, Professor E. E. Bogue, by my son, W. E. Kellicott and by many students of the Ohio State University.

It does not seem necessary to give here an account of the anatomy and metamorphosis of the dragonflies; this has been done quite recently in papers by Nathan Banks,[1] Philip P. Calvert,[2] and by Professor J. H. Comstock,[3] nor will the bibliography be repeated, as it

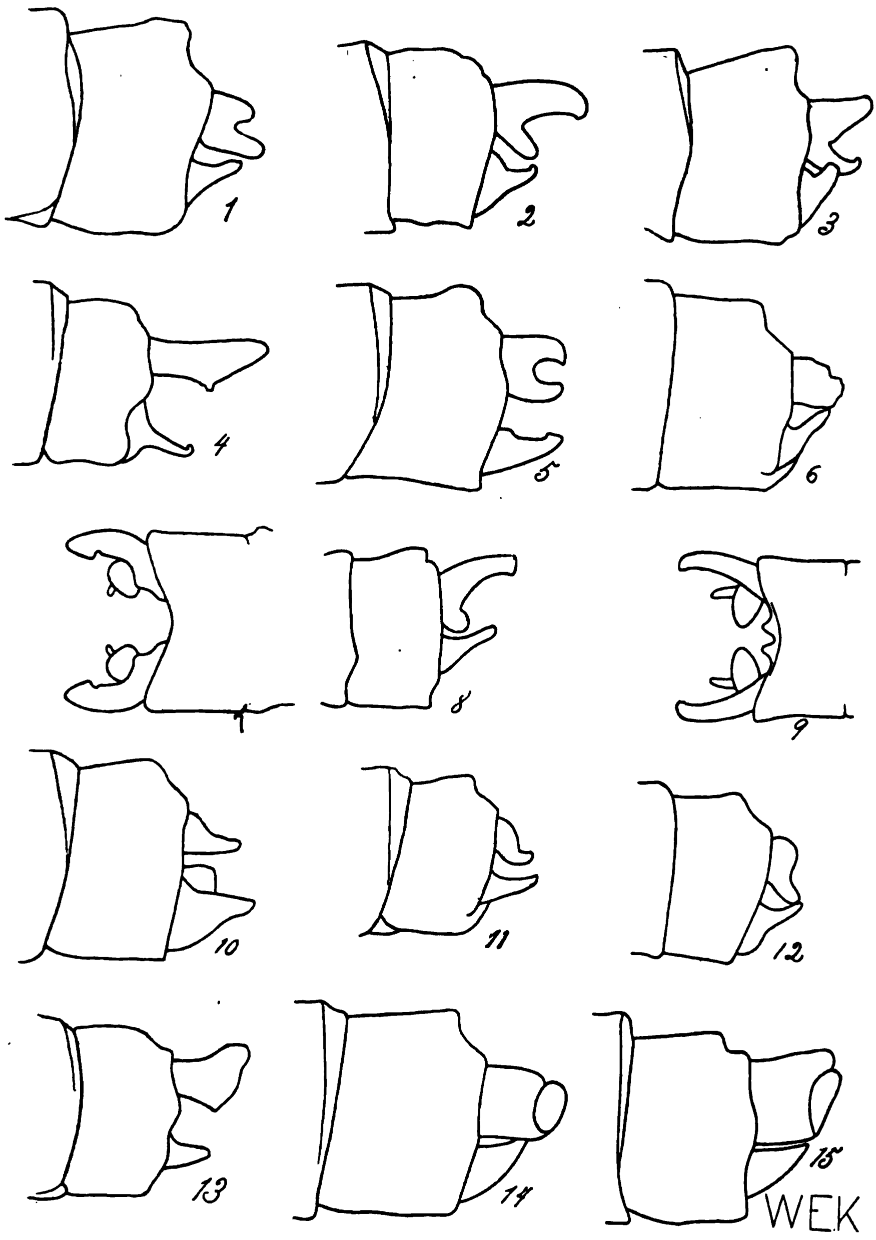
(1.) A Synopsis Catalogue and Bibliography of the Neuropteroid Insects of Temperate North America. *Transaction of the Am. Ent. Soc.*, of Philadelphia, Vol. XIX.
(2.) Catalogue of the Odonata of the vicinity of Philadelphia, with an Introduction to the Study of this Group of Insects. Ib. Vol. XX.
(3.) Manual for the study of Insects, Ithaca. N. Y., 1895.

is accessible to most students in the papers cited and in the Synoptic Catalogue of W. F. Kirby. References will be made, by foot notes, to descriptions made since the papers cited were published.

Dragonflies occur in most parts of the earth. Representatives of this ancient race fly beyond the Arctic Circle and at an elevation of 10,000 feet. However, they are heat-loving insects and of course are more numerous in tropical and sub-tropical countries than elsewhere. The number of known species in the whole world exceeds 2000; in North America about 300; and in Ohio 100.

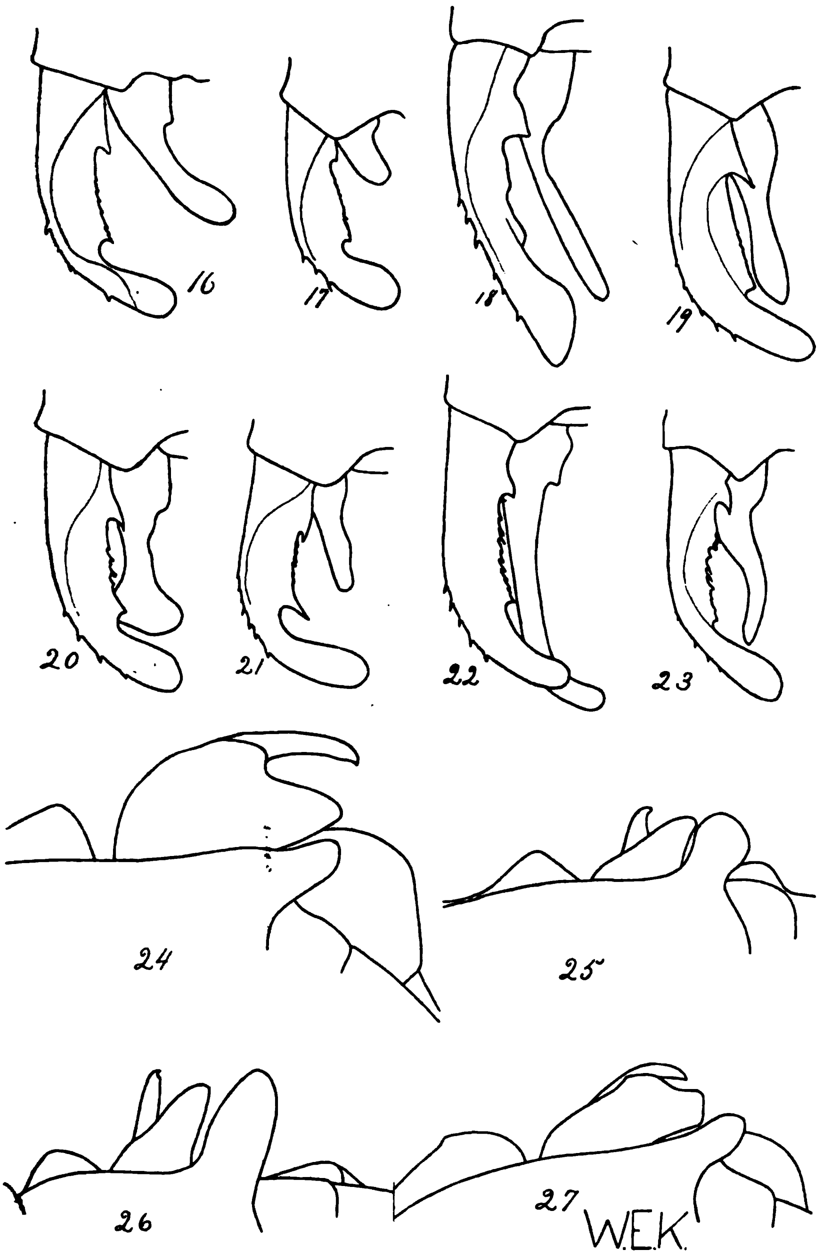
The Odonate fauna of Ohio is essentially rich in species and in the number of individuals. The great lake system on the north, and the Ohio River on the south afford favorable conditions for their life, and avenues for their approach from south-west and north-west; while our diversified area with its numerous rivers and morasses is not an unfavorable habitat. The number of living species listed for Great Britain is forty-five, for France seventy, and for all Europe one hundred and twenty. Still our Century of Odonates, it is supposed, represents a waning race; once, when the climate was more nearly tropical, the number was probably much greater. A question of equal interest is whether the results of the changes incident to civilization have produced a diminution of our resident species. There is an impression abroad that we have lost species in, for example, the present century; that some species cannot withstand the consequences of stream pollution, drainage of morasses, and the more inconstant character of the streams and ponds. There are no data for determining the question. It is the opinion of the writer that some few forms once residents are no longer within our limits, but that others have taken up their homes here at the same time; in fact it appears probable that the number has increased rather than diminished up to the present time.

The pronounced individuality of the Dragonflies has attracted the attention of people to them quite universally and strongly. This is shown by the awakened imagination shown in the many and often strikingly significant popular names. The Germans call them "*Wassernympfe*," the Dutch "*Scherpstekendevlieg*," the French "*Demoiselle*," the Portugese "*Mosca que da grandes picacas*," the Italians "*Saetta*," the English Dragonflies or Horsestingers, while in our own country we may have not only the English names but others quite as forcible; for example, "Spindles," "Mosquito-hawks." "Snake-feeders," "Snake-doctors," "Darning-needles," or to be more profane "Devil's darning-needles." These names most happily express the characteristics of these veritable dragons of the air and water. It has been said that "some of these names testify to the wide spread, but quite unfounded, belief in the harmfulness of these creatures to man." The writer recalls at least one grown person who truly believed they were harmful. This was a school teacher, who impressed upon him, and others of her charge, that the devil's darning-needles about the "old swimmin' hole" were dangerous, and that they were quite determined to sew up the ears of truants who sought the limpid waters and grass-covered banks of the millrace, rather than the hard and strict ways of the prosy school-room. This is the one "fact" of Natural History he remembers to have been taught him in the "district" school.



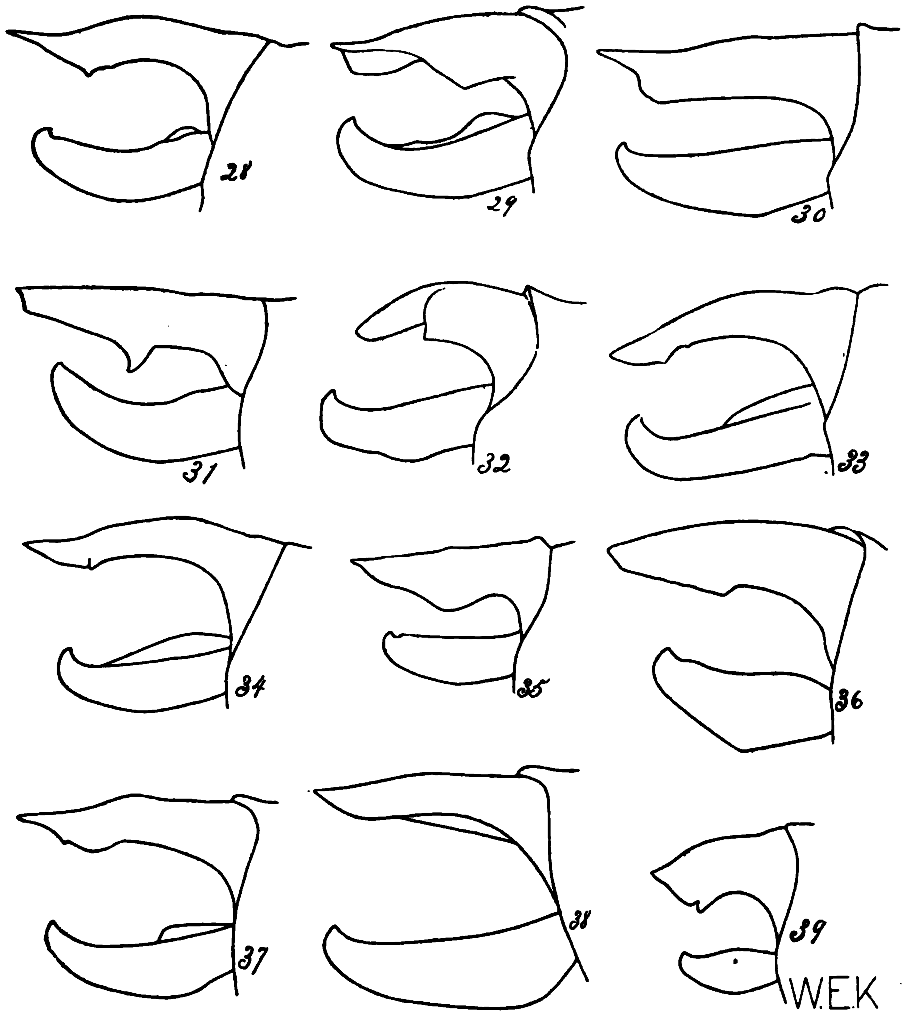
EXPLANATION OF FIGURES.

1. Lateral view of ♂ abdominal appendages of *Enallagma exsulans*.
2. Same *E. aspersum*.
3. Same *E. fischeri*.
4. Same *E. signatum*.
5. Same *E. ebrium*.
6. Same *E. doubledayi*.
7. Dorsal view ♂ abdominal appendages *E. aspersum*.
8. Lateral view ♂ abdominal appendages *E. traviatum*.
9. Dorsal view ♂ abdominal appendages *E. traviatum*.
10. Lateral view ♂ abdominal appendages *E. hageni*.
11. Same *E. geminatum*.
12. Same *E. divagans*.
13. Same *E. pollutum*.
14. Same *E. carrunculatum*.
15. Same *E. civile*.



EXPLANATION OF FIGURES.

16. Dorsal view left ♂ abdominal appendages *Lestes disjuncta.*
17. Same *L. congener.*
18. Same *L. vigilax.*
19. Same *L. forcipata.*
20. Same *L. uncata.*
21. Same *L. rectangularis.*
22. Same *L. inæqualis.*
23. Same *L. unguiculata.*
24. Lateral view external ♂ genital organs of second abdominal segment of *Diplax rubicundula, as* seen when the insect is turned upside down.
25. Same *D. semicincta.*
25. Same *D. vicina.*
27. Same *D. obtrusa.*



EXPLANATION OF FIGURES.

28. Lateral view ♂ abdominal appendages *Gomphus fraternus.*
29. Same *G. graslinellis.*
30. Same *G. villosipes.*
31. Same *G. spicatus.*
32. Same *G. furcifer.*
33. Same *G. externus.*
34. Same *G. vastus.*
35. Same *G. exilis.*
36. Same *G. plagiatus.*
37. Same *G. lividus.*
38. Same *G. spiniceps.*
39. Same *G. quadricolor.*

The Systematic Place of the Odonata.

The orders of insects fall naturally into two groups: those having incomplete metamorphosis, *Heterometabola*, and those in which the metamorphosis is complete, *Metabola*. In the latter group of orders there are four sharply separated stages,—egg, larva, pupa and imago; in the former the changes incident to the period of adolescence are gradual, so that the larval and pupal stages are not sharply defined. The young continue active and feed from birth until the final change to imago. Such growing insects are called nymphs.

They are arranged by Professor J. H. Comstock, as follows:

Heterometabola.	**Metabola.**
Thysanura.	Neuroptera.
Ephemerida.	Mecoptera.
Odonata.	Trichoptera.
Plecoptera.	Lepidoptera.
Isoptera.	Diptera.
Corrodentia.	Siphonaptera.
Mallophaga.	Coleoptera.
Euplexoptera.	Hymenoptera.
Orthoptera.	
Physopoda.	
Hemiptera.	

Thus the Odonata or Dragonflies rank among least specialized insects; those most nearly related to the

primative stock; to those orders having representatives at lower geological horizons than *Metabola*. They present, however, some contrasts and exceptions to those of related orders. In these the head thorax and abdomen are sharply separated as in *Metabola*. They are active, powerful and boldly predaceous. Their nymphs, as well as the adults, exhibit the malignant side of life that lived and sported about the marshes of the remote Tertiary Period.

LESSER GROUPS OF THE ORDER.

The Order *Odonata* is divided into two sub-orders:

I. *Zygoptera* in which both pairs of wings are similar and which in repose are held vertically; the males have two inferior abdominal appendages and the nymphs have three caudal gill-plates; and II. *Anisoptera* in which the two pairs of wings are dissimilar, in repose they are held horizontally; the males have one terminal inferior abdominal appendage, and the nymphs have no terminal gill-plates.

Our representatives of the Order may be arranged in the following lesser groups:

ORDER ODONATA.

I. SUB-ORDER ZYGOPTERA.

1. FAMILY AGRIONIDÆ.

(1) Sub-family Calopteryginæ.
(2) Sub-family Agrioninæ.

II. SUB-ORDER ANISOPTERA.

2. FAMILY ÆSCHNIDÆ.

(3) Sub-family Gomphinæ.
(4) Sub-family Corduligasterinæ.
(5) Sub-family Æschninæ.

3. Family Libellulidæ.

(6) Sub-family Cordulinæ.
(7) Sub-family Libellulinæ.

Key to the Foregoing Sub-families.

1. Wings alike, closed vertically in repose, eyes far separated..........2
   Not as above..........3
2. More than two antecubitals..........(1) *Calopteryginæ.*
   Only two antecubitals..........(2) *Agrioninæ.*
3. Antecubitals of the first and second series, not corresponding throughout..........4.
   Corresponding throughout..........5.
4. Eyes separated by a wedge-shaped occiput..........(3) *Gomphinæ.*
   Eyes barely touching..........(4) *Corduligasterinæ.*
   Eyes touching for a short distance..........(5) *Aeschninæ.*
5. Eyes tuberculated behind..........(6) *Cordulinæ.*
   Eyes not tubercled..........(7) *Libellulinæ.*

THE FIRST SUB-FAMILY.

CALOPTERYGINÆ.

The species of this sub-family are among the most beautiful of dragonflies. Their bright metallic colors, their clouded and reticulated wings, their slender and graceful bodies at once attract attention. Their flight is not strong and they seldom wander far from the grassy borders of native pond or stream, where in turn they are to deposit their eggs and where their young are to be matured. While our species are few, most of them are common and occur everywhere; they belong to genera determined as follows:

1. Basilar space free, wings broad..........*Calopteryx.*
2. Basilar space reticulated, wings narrower..........*Hetærina.*

CALOPTERYX, Leach.

Only two species are known within our limits. Two different species—*C. elegans* and *C. dimidiata,*

have been taken in Kentucky and doubtless will yet be found on this side of the great river.

The species of the genus are arranged in two groups, thus:

1. Wings spatulate, *i. e.* anterior and posterior margins of the wings not parallel.
   (1.) Wings uniformly velvety black, (brownish in young). *maculata.*
   (2.) Wings hyaline basally, apical third or fourth blackish. *æquabalis.*
2. Wings not spatulate, *i. e.*, anterior and posterior margins nearly parallel.*

*No representatives as yet recorded from the State.

1. *Calopteryx maculata*, Beauvois.

Length: of hind wing, ♂ 28 mm., ♀ 30; of abdomen ♂ and ♀ 37 mm.

The males are metallic blue or green; the antennæ, under parts of head and thorax, legs, a broad humeral stripe, the thoracic sutures and under parts of the abdominal segments 1-7 are black; segments 8-10 and inferior appendages below are light—sometimes the black extends to 10 or even to the appendages. The wings are velvety black in the adult, some shade of brown in the young.

The superior appendages are forcipate, at base nearly cylindrical, narrowing to the middle at which they suddenly expand interiorly to the somewhat swollen and slightly decurved apex; the distal half bears several stout denticles on its outer margin. The inferior appendages are shorter, truncate, somewhat curved inward and upward, with a sharp incurved tooth at inner angle.

The females have the head and thorax similar to the males, but with more blackish shades and the abdomen brassy brown with a pale light or white dorsal band on 8-10, broader on 9 and often including a part of 7. Abdominal appendages nearly as long as 10, slender, pointed and black. The wings are similar

to those of the young males, often darker apically, especially on the hind wings; the pterostigma (absent in the male) is milk white, broad and reticulated; it varies greatly in size, but is always relatively broad.

This species is found throughout the State, and is abundant in most localities. It prefers small streams, especially the meadow-brooks and the clear, cool rivulets from springs among the hills. It also occurs by the borders of larger living waters where the banks are overhung by foliage. In this form, the male does not always seize the female with his feet previous to clasping her prothorax with the abdominal appendages. He flits about her, when at rest, gradually approaching, and, finally, the female not attempting to avoid him, he poises himself with sufficient accuracy to pick her up by the prothorax, when they fly away together. The female places her eggs among the rubbish and mud along the borders of the ditches.

In central Ohio it occurs from May 15 to September; it is most abundant in June.

It is perhaps true of all of this sub-family, but especially true in case of *maculata* that the males engage in fierce battles. Two combatants will fly about each other, evidently with consuming rage, when one finally appears to have secured a position of advantage and darts at his enemy attempting, often successfully, to tear and damage his wings. These battles often last a long time, until the participants are apparently exhausted. Sometimes a third and a fourth happen along and "take a hand" when the melee becomes general, each doing his utmost to damage any other that he can seize.

1. *Calopteryx æquabilis*, Say.

Length; of hind wing ♂ 32 mm., ♀ 33; of abdomen ♂ and ♀ 40.

The male is metallic green; the following black; the head except the clypeus, thoracic carina, a narrow humeral stripe, more or less on thoracic sutures, the legs and the abdominal appendages. The wings are hyaline, except the tips, with a shade of brown which is golden at certain angles, the tips are deep brown to black, as follows: the anterior with one fourth or one third black, irregular on inner border, the posterior with one third or one half straight within.

The superior abdominal appendages are forcipate, on the inner surface there is a sinus at the middle followed by a stout tooth, the apical portion is thick, apex obtuse, outer margin denticulate; the inferiors are shorter, stout, and straight seen from above, strongly curved upwards, the apex with an incurved apical hook; the surface of these organs is rough and in optical section appears serrate.

The female agrees closely in color with the male, the tip of abdomen becoming brownish with a light band on 8–10; and on sides of 5–10; there are light lines above the thoracic feet. The abdominal appendages are shorter than 10, stout, acute. The wings are lighter apically than in the male; the pterostigma is narrow, not reticulated, milk white.

Compared with *maculata*, *æquabilis* is a little larger, but more slender; the body is more decidedly metallic green; the male appendages are similar, but differ sufficiently, they are rougher, that is, the denticles are more numerous and stouter, the strong tooth on the inner curve is wanting in *maculata*, the inferior are straighter, stouter and rougher than in *maculata*. The wings besides their difference in color are not quite so spatulate; the pterostigma is very different.

Æquabilis has been taken thus far only in the central part of the state in the first of summer. Its habits appear to be similar to those of *maculata* except it has

not been noticed about rivulets. as it prefers the borders of larger streams.

HETÆRINA, Hagen.

As yet two only of the several charming species accredited to America have been taken in Ohio. Others, however, occur in states south and west, so there are still regional species that may be added. In habits they resemble *Calopteryx;* their bronzed body, narrow, hyaline wings with brilliant, basal areas in the males, at once distinguish them.

1. Tips of the wings, especially the anterior, brown; base of fore wings, crimson, hind, brown.. *tricolor.*
2. Tips of the wings of male not spotted with brown; base of both pairs crimson.. *americana.*

Hetærina americana, Fabricius.

Length; of hind wing, ♂ 28 mm., ♀ 30; of abdomen ♂ 36 mm., ♀ 32 mm.

In the males the head and thorax are coppery red, in the fully adult, in younger examples metallic green; the labrum and labium are pale with a black dot in the center of the former; the genæ and mid-dorsal carina are black; there is a white humeral line, a similar one on first lateral suture, a broader stripe at the second suture with the ventral surface and the posterior lateral border of the metathorax white; all the white lines and stripes are bordered more or less with black. The wings are hyaline with a shade of brown at the tips and with the basal fourth bright red except costa of fore wing: these basal patches are pale in the young on the front wings and brown on the hind ones. The pterostigma is very small, yellowish in the young, light brown in the fully adult. The dorsum of the abdomen is metallic green, becoming obscure and coppery with age, yellowish at the sides; the venter is blackish except on 1-2 and 9–10 which are yellowish, there are yellow-

ish narrow interrupted rings on 3–7, and a more or less distinct mid-dorsal, light line on 2–7.

The superior abdominal appendages are forcipated, light below and darker above especially towards the apex; the outer surface is denticulate in the middle; there are two smooth horizontally flattened protuberances on the inner side, the proximal one is the larger, the rounded apexes of these processes are directed away from each other.

The inferior appendages are broad at base, then narrow and cylindrical, the truncated apex reaches to the larger tubercle of superiors and bears a stout denticle on its inner angle.

The females have the head, thorax and abdomen metallic green, the last becoming obscure with age. There are markings of other colors as follows; antennæ (except basal joints), a dot in middle of labrum, mid-dorsal carina, the tarsi, the outer side of legs and sternum black; the under side of head and thorax, sides of abdomen (except a dark apical spot), basal interrupted ring on 1–7, a mid-dorsal line on 1–10; basal joints of antenna, labrum, edges of the prothorax, humeral stripe and stripes on the side as in the male, white. The wings are hyaline, costa black, basal third and front margin pale yellowish brown. Pterostigma white, surrounded by black veins. The abdominal appendages and valves are yellowish, the latter tipped with black.

This brilliant gem is peculiarly restricted in its scene of flight. It is rarely observed more than a few feet away from its accustomed habitat, the water's edge. Another notable habit is that of congregating, sometimes in companies of hundreds. These assemblies commence in the afternoon and do not disperse until the warmth of the following day awakens them to activity. Both sexes take part in these assemblies and they rest so compactly that a single sweep of the net

may capture scores of them. A slender, drooping twig of the willow, loaded with these beautiful insects looks like a string of rubies and presents a beautiful picture.

The species occurs throughout Ohio, and it may be found from mid-summer until late in October by running waters, especially where the flow is rapid over rocks and pebbles and the borders are overhung by the spray of willows or coarse aquatic plants.

Hetærina tricolor, Burmeister.

Length of abdomen ♂ 41, ♀ 35, of hind wing ♂ 30, ♀ 30.

Male deep blackish brown, thorax reddish brown, mid-dorsal thoracic carina black, humerals narrow, pale, yellowish apical rings on 1-4; legs black; wings hyaline, tips of all brown, more on hind wings; basal fourth of fore wing crimson, except between the first and second antecubitals, hind wings brown at base except hind margin; pterostigma nearly black, small.

Abdominal appendages black, less forcipate than in *americana*, as long as 10, exteriorly toward the apex there are coarse teeth, within at base a blunt hairy tubercle followed by a blade whose margin is first excavated, then convex and truncated distally; the inferiors are half as long, upturned apically with two terminal sharp tubercles.

The female is bronze green ornamented with pale buff. The face, antennæ, except terminal half which is black, and occiput buff; prothorax has the posterior lobe elevated and rounded in the middle, bordered with buff and with a geminate, orange spot in the middle and with a wash of the same at the sides; thorax green, mid-dorsal black stripe, buff either side uniting with humeral of the same color; sides buff with green spot on each ring; legs green and pale, tarsi black; wings flavescent throughout; ptero-

stigma white. Abdominal dorsum with green and pale and interrupted apical yellow rings on 2-7; ten with a dorsal carina and apical thorn; appendages conical pointed; valves short, dark.

This very handsome species occurs along the Ohio river and ascends the larger streams as far as the central district. It is not rare, but far less abundant in its range than *americana*. It flies much more rapidly than the other, otherwise its habits appear to be similar. It prefers the borders of streams where the flow is rapid.

THE SECOND SUB-FAMILY.

AGRIONINÆ.

This group includes the smallest dragonflies, in fact all Ohio species are small. Not so in tropical America, where representatives are known that are the most gigantic of living odonates.

Our feebler inhabitants of the river bottoms may be seen in numbers on any warm summer day flitting among the sedges of the shallows or busy placing their eggs among floating aquatics. They are not seen flying high in the air or patrolling the beach in search of mates or food, for they seek their kind and prey in the low thickets of aquatic foliage. Many are dull in color, many are brilliant; green, blue and yellow are favorite colors. All are graceful and charming.

The genera may be outlined and limited by the following synoptically arranged characters:

1. Median and submedian sectors arising nearer the arculus than the nodus.............*Lestes*.
   Median and submedian sectors arising near the nodus...............2.
2. Bristles on the legs, long,—each about twice as long as the distance from the base of one to the next.............*Argia*.
   Bristles on the legs shorter...............3.
3. No ventral spine at end of 8 in the female...............4.
   A ventral spine at end of 8 in female...............5.

4. No postocular spots .... *Erythromma.*
   Two postocular spots .... *Nehalennia.*
5. The tenth segment of the male a little prolonged above, the process bifid; pterostigmas on fore and hind wings of male of different color .... 6.
   The tenth segment of male without the superior bifid process (Except in *exsulans* and *fischeri*). Pterostigmas on wings of male similar .... *Enallagma.*
6. No postocular spots .... *Amphiagron.*
   Two postocular spots .... 7.
7. Pterostigma remote from the costa in the male ..... *Anomalagrion.*
   Pterostigma normal in position in the male .... *Ischnura.*

LESTES, Leach.

In W. F. Kirby's Catalogue of the odonates of the world, thirteen species of Lestes are ascribed to the Nearctic region; of these, eight have been taken in the state and there is, at least, one more that is very likely a resident, Viz: *L. urina* as it has been taken in Illinois and Pennsylvania

Our species belong to three groups, separated by the relative length of the inferior and superior abdominal appendages of the males:

1. Inferior pair shorter than half the length of the superiors, *congener*, (*eurina*).
2. The same more than half, but no longer than the superiors:
   (1) Inferior appendages of the male sigmoid .... *unguiculata.*
   (2) Same straight, abruptly widened apically .... *uncata.*
   (3) Same not widened apically .... *disjuncta.*
   (4) Same gradually and slightly widened, a little larger than *disjuncta*, two teeth on the inside of the superiors, basal one larger, (equal in *disjuncta*) .... *forcipata.*
   (5) Same long, bent downward apically, abomen of the male very long .... *rectangularis.*
   (6) Same long, very slender not dilated apically .... *vigilax.*
3. The same longer than the superiors apex turned inward, *inæqualis.*

Lestes congener, Hagen.

Length: of hind wing, ♂ 18-22 mm., ♀ 22 mm.; of abdomen ♂ 27-31 mm., ♀ 28 mm.

The general color of both sexes is blackish bronze. The labrum, anteclypeus, genæ, under side of the head,

a narrow humeral stripe (sides parallel) the prothoracic borders, mid-dorsal carina (obscure in some) the sides of the thorax and abdomen and stripes on the femora and tibiæ yellowish white. There are also whitish apical and basal interrupted rings on 2-7 of the abdomen and a trace of a mid-dorsal white line. segments 9 and 10, rear of head and under parts of thorax in the male are pruinose. The wings are hyaline, pterostigma reddish brown, covering two cells.

The male abdominal appendages are forcipate, longer than 10, reddish on the outside basally, otherwise black, denticulate externally, apex somewhat swollen; on the inner surface there is a strong pointed proximal tooth, followed by a sinus, this followed by a blade, the inner edge of which bears sharp teeth. The short inferior appendages are black with their obtuse apices turned towards the mid-line.

The female differs in having the mid-dorsal line of abdomen plainer than in the male; the humeral stripes wider and the pterostigma lighter. The slender abdominal appendages are light without and black within; the valves are light, with tips and lower edge blackish, serrate and narrow.

Congener probably occurs in the greater part of the state. It has been taken at Columbus in the fall only, flying well into October.

Lestes unguiculata, Hagen.

Length: of abdomen ♂ 28 mm., ♀ 27 mm.; of hind wing ♂ 19 mm., ♀ 21 mm.

The color of the head and thorax blackish bronze above, dorsum of the abomen metallic green; the labrum, genæ, under parts of head and thorax, greater part of the sides of the latter, and humeral stripe yellowish. The wings are hyaline, pterostigma brown with the ends whitish; the coxæ are light, the femora and tibiæ, striped with light and black, tarsi black.

Abdominal segments 1-7 are light on the sides, while the last three are black or bronze throughout, there are narrow interrupted basal rings on 2-7.

The male abdominal appendages are forcipate, brownish at base, black apically, denticulate without, on the inner margin is a blade which is narrow concave at the inner margin and denticulate, this blade is preceded by a sharp backwardly directed spine; the inferiors are black, except on the under side of the swollen base, long and sigmoid.

The female has the appendages slender, reddish with black tips. Her colors differ little from those of the male; the humerals are more conspicuous and widest below, the rear of the head has a yellow band from eye to eye—obscure in old specimens; there is a faint mid-dorsal line on the abdomen, and both sexes are more or less pruinose when adult.

This species has been found very abundant in the northern parts, near the lake and in the central section. It is on the wing from mid-summer until October.

Lestes uncata, Kirby.

Length: of the abdomen ♂ 31 mm.. ♀ 28 mm., of the hind wing ♂ 22 mm., ♀ 24 mm.

The color of both sexes is metallic green, becoming blackish on the last abdominal segments. The following are yellowish white: labrum, genae, clypeus anteriorly, labium, sterumn and sides of thorax (except a blackish wash on sides of metathorax), a humeral line, mid-dorsal carina more or less in the female, the sides of 1–7, basal rings on the same, the coxæ, the femora interiorly, and the tibiæ exteriorly. The following are black: the tarsi, exterior of femora, interior of tibiæ apical rings on 2–9, the last two abdominal segments in the male, and the pterostigma which is terminated by white veins.

The female has the sides of the thorax clear yellowish and less black on the abdomen; the appendages are light and the valves black with light shade above; the basal half of abdominal ring 1 is yellow, and the basal rings on 2–7 are interrupted (not in the male).

The superior male abdominal appendages are much like those of *unguiculata*, while the inferiors differ totally, as they are straight with a broad terminal expansion, making them securiform when seen from above.

This species occurs in most parts of the state and in abundance; it appears during mid-summer.

Lestes disjuncta, Selys.

Length: of abdomen ♂ 30 mm., ♀ 28 mm.; of hind wing ♂ 20 mm., of ♀ 22 mm.

Head and thorax blackish brown, abdomen metallic green with the last three segments blackish. The following parts are yellow: lips, genæ, anteclypeus, mid dorsal carina, humeral stripes, sides of thorax, femora interiorly and tibæ exteriorly, sides of abdominal rings 1–7, and narrow, basal, interrupted rings on 2–7 of the female and young males, not discernible in adult males. The sides of the metathorax of the females is blackish, and in the males there is at least a dark wash at the second lateral suture. The humeral is wider in the female, and in both sexes it is narrower above.

The superior male abdominal appendages are black, forcipate, rather coarsly denticulate without, and with two equal acute teeth within, the edge of the blade-like piece between them is straight and serrate; the inferiors are reddish brown, straight, somewhat laterally expanded distally, and concave on the upper side or spoon shaped. The female appendages are of the usual shape, blackish within and at apex; the valves are light with a dark shade through the middle.

Both sexes are more or less pruinose on the rear of head, thorax, base and apex of abdomen.

This species is common and wide spread.

Lestes forcipata, Rambur.

Lenth: of abdomen ♂ 33 mm., ♀ 31 mm.; of hind ♂ 22 mm., ♀ 24 mm.

Color blackish bronze, abdomen brighter.

The following yellowish or greenish white: anteclypens, labrum, genæ, labium, sternun of the thorax, coxæ, stripes alternating with black upon the legs, thoracic carina, borders of the prothorax, sides of the thorax, abdominal joints, and basal interrupted rings on 3-7. The humerals in both sexes are wide, narrower above. The pterostigma is large, blackish brown with the veins at the end whitish. The ninth segment of the male is conspicuously pruinose.

The superior abdominal appendages of the male are reddish outwardly at the base, otherwise black, forcipate, with a few coarse teeth on the outside, within a blade preceded by a stout tooth and terminated by a prominent angle, the blade is followed by a deep rounded sinus. The inferior appendages are reddish, somewhat expanded distally and slightly curved inwards. The appendages of the female are light without and dark within; the valves are black on the lower border and light above.

The species is easily separated from *disjuncta* by its larger size, by the unequal teeth at the end of the lamina of the male abdominal appendages, by the wider humeral stripes about equal in the sexes and by the fact that the inferior male appendages are widened before the apices.

Taken commonly at Columbus, April 24, 1896. Also at Sandusky in June.

Lestes rectangularis, Say.

Length: Abdomen of ♂ 40 mm., of the ♀ 33 mm.; hind wing ♂ 22 mm, ♀ 23 mm.

Head, thorax, and abdomen of the female above and the last four abdominal segments of the male blackish brown: the abdomen of the female is sometimes greenish bronze with a mid-dorsal light line on 1-2 or 3. The anteclypeus, lips, genæ, under parts of the head and thorax, the thoracic carina, humerals, and sides of the thorax are yellowish or greenish white. The legs are pale with black as follows: a narrow stripe (may be wanting) on the exterior of the second and third femora; two on the first pair; also on the inner side of first tibiæ, the ends of the tarsal joints and the claws are brownish. In the female the stripes on the legs are wider and the tarsi blacker than in the male. In the male the top of 1 and 2 are brown; 3-6 testaceous with basal lighter rings and apical darker ones. In the female 1-10 are yellowish on the sides, the same extending over the dorsum as narrow basal rings on 1-6. The superior appendages of the male are testaceous, blackish on apical third, forcipate, no denticles out side; the lamina on the inside is short with long and slender, terminal and minute marginal teeth. The inferior appendages are black, exceeding the lamina of the superiors and bent downward at the end. The appendages of the female are slender, conical, testaceous, tips black. The valves are narrow and black below.

Rectangularis occurs abundantly in all parts and may be recognized by the very long male abdomen and pale color of body and legs.

Lestes vigilax, Hagen.

Length: of abdomen ♂ 40 mm., ♀ 37 mm.; of hind wing ♂ 26 mm., ♀ 27 mm.

Bright metallic green obscure towards the end of the abdomen, and covered by pruinose on rear of head, thorax, base and apex of abdomen in the fully adult.

The males are marked with black, yellowish and bluish white as follows: white—genæ, lips, under parts of thorax, irregular bands before the lateral sutures, humeral line (often faint), in some the edge of the carina, coxæ, trochanters, more or less of the inner side of the femora, and pleuræ of abdominal joints 1–6; black—legs and feet except as mentioned above, antennæ, mid-dorsal thoracic carinæ (its edges sometimes light), and the superior abdominal appendages. The pterostigma is yellowish in both sexes, surrounded by black veins and covers about three cells.

The female differs from the male in having wider humeral, and carinal yellowish stripes, sides of thorax yellow, the light on the femora more pronounced, the light of the abdominal pleuræ extending over the dorsum as narrow basal rings, and the greater part of 9 and 10 yellow,

The superior male appendages are long, less curved than in the preceding species, the ends are somewhat enlarged and obliquely truncated. The blade of the inner side is preceded and followed by a tooth, its edges are not straight but coarsely crenated. The inferior appendages are pale, very slender, and reach nearly to the end of the superior, they are slightly bent inwards at apex. The appendages of the female are yellow, the valves of the same color.

This slender species is very active and graceful in its movements. It has been recorded only for the lake district. In the marshes at Sandusky Bay it occurs in immense numbers.

Lestes inequalis, Walsh.

Length: of abdomen ♂ 39 mm., ♀ 37; of the hind wing ♂ 27, ♀ 28.

Metallic green, with the last three abdominal joints blackish. The markings of yellow or bluish white are as follows: male—anteclypeus, lips, genæ, rear of head, under parts and sides of thorax below, an exceedingly narrow stripe on the carina and humeral suture, two stripes on the femora, most of the tibiæ and the pleuræ of the abdominal segments; there are very narrow basal rings on 3-7. The antennæ, tarsi and stripes on tibiæ and femora are black. The pterostigma is dark brown covering two to three cells. The female differs in having more black upon the legs, the humeral and carinal stripes wider.

The male abdominal appendages are black; the superiors are forcipate with a few spines on the outer curve, within a stout acute tooth precedes the usual blade which is narrow, the edge curved and serrate. The inferiors are slender and strongly bent inwards at apex. The anal appendages of the female are slender, rather long and blackish in some examples, light in others; the valves are narrow and black except on the upper border.

This beautiful species is quite as active and wary as *vigilax*, which it closely resembles, it is easily separated however; the males by their peculiar inferior appendages, bright yellow sides of thorax and absence of humeral strips; the female by the yellow rear of the head, bright yellow on sides of thorax, darker valves and pterostigma and the narrower humeral stripes (sometimes wanting as in the male).

It has been taken only in northern localities.

ARGIA, Rambur.

The species of this genus differ only slightly from those of other genera following, yet they have a "personality" that no observer can long fail to appreciate. They prefer the brook-sides and some of the species rarely wander to other localities; the nymphs live in the

clearer, running waters; to this there is one exception, the young of *putrida* live also in deep water of Lake Erie, and the nymphs swarm about its shores and islands.

Our five species fall into the two groups defined by the number of cells covered by the pterostigma.

A. Pterostigma covering more than one cell (one and a part of another)........................*putrida.*

B. Pterostigma covering one cell; males as follows:

(1). Violet and black, 8, 9 and 10 violet; inferior appendages thick, much longer than the superiors and slightly notched...*violacea.*

(2). Bluish and black; 9 and 10 blue; inferior appendages longer than the superior, apex bifid, upper branch longer.........*tibialis.*

(3). Light blue and black; 8, 9 and 10 blue; inferior appendages bifid, branches equal........................*apicalis.*

(4) Deep blue and black ; 8, 9, and 10 blue; inferior appendages longer, strongly bifid, branches divaricate, lower longer, stout, *sedula.*

Argia putrida, Hagen.

Length; of abdomen ♂ 33, ♀ 31; of hind wings ♂ 24, ♀ 25.

The young are clay colored to light brown, the older males are darker to black obscured by pruinose especially on the head, thorax and segments 9 and 10. Three pale antehumeral stripes, also one on the sides of thorax and narrow pale basal rings on 3–7. Segments 8–10 are somewhat thickened with the last excised, sides of the excison thickened and produced backwards into rounded tubercles. The abdominal appendages are very short, black, the superiors are flattened, obliquely rounded at the end with two teeth on the lower and outer side, one at the lower inner apex, the other on the outer middle face, there is a sulcus between them; the inferiors are much wider vertically, beveled to an irregular tuberculate edge posteriorly and terminating above in finger-like projection that lies between the tubercles of the superiors.

The young females have a similar coloration to the young males. The fully adults are light blue marked

with black as follows: antennæ, lines about the vertex and frons, lines on the sides and edges of prothorax humeral and second lateral sutures and dorsum of the abdomen. The blue of the sides extend as basal rings on 3–7; ten is blue. The appendages are pale, short and blunt; the valves short, pale smoky below, serrated.

Putrida occures throughout the State, in vast numbers along Lake Erie and about the islands; it often comes on ship-board far from land. It flies from May to October. The female, usually attended by the male, oviposits on submerged timbers and moss, and alga-ladened stones. It is not uncommon, to see the female and her consort descend beneath the water and to remain submerged for what would appear to be a long time.

The following observations were made one day on its habit of ovipositing under water. Five pairs were noted on a timber of a dock; they were from barely covered to six inches under water; the following notes were made at the time.

PAIR 1. ♂ abandoned ♀, emerged and flew away after five minutes, ♂ remained one hour.

PAIR 2. ♂ abandoned ♀ in seven minutes, ♂ remained fifty-five minutes; after exposure to the air for a short time she returned beneath the water for fifteen minutes.

PAIR 3. ♂ remained submerged twenty minutes, ♀ thirty; she flashed her wings and immediately returned for twenty-five minutes.

PAIR 4. They were disturbed, emerged and flew away together.

PAIR 5. They were seen to alight on the dock just above the water and slowly back down until they were covered.

Argia violacea, Hagen.

Length: of abdomen ♂ 26, ♀ 25; of hind wing ♂ 20, ♀ 21.

The color of the adult male is violet ornamented with black as follows: antennæ, dorsum of prothorax in part, mid-dorsal and humeral stripes, the latter bifid beneath the wings, the upper part of the first and the whole of the second lateral sutures, stripes on femora and tibiæ, the sides of 2, apical lateral spots extending as rings on 3-6, all of 7, the abdominal appendages, the venter of the abdomen (widest on 8-10). The sides and venter of thorax, coxæ and greater part of legs pale. The pterostigma of both sexes is light yellow or brown. Wings slightly fumose.

The female has the violet less bright than the male, the younger ones clay colored, the black on sides of dorsum of 2-6 is in bands rather than spots leaving basal rings, however, there is a mid-dorsal line on 7.

In the males 10 is excised as in *putrida* but the posterior angles are not knoblike but sharp. The superior appendages are short, in profile the sides are parallel and the apex rounded, from above they are broader with apex obliquely truncated, beneath they are excavated apically with a stout curved process at the inner angle; the concavity contains a tuft of hairs. The inferiors are much longer and deeper, bifid with the upper, pointed, larger prong directed towards the superiors; the lower, rounded one is directed downward.

The appendages of the female are pale, short, blunt and the valves are also pale and serrate.

The species is common along the borders of ditches and streams. Oviposition takes place as in other *Argias*—often in pairs, on submerged plants and rubbish. It is every-where its proper habitat is found, occuring in mid summer.

Argia tibialis, Rambur.

Length: of abdomen ♂ 27, ♀ 27; of the hind wing ♂ 21, ♀ 22.

Color bronze black variegated with lilac or blue as follows: frons, clypeus, lips, broad stripe each side of thoracic dorsum; sides of thorax with second lateral suture black, more or less of sides of 1-7 more in female, with basal yellow rings on 3-7 in both sexes, the dorsum of 9 and 10 in the male. The legs have more or less of pale, pterostigma dark brown.

The male has 10 incised as in the preceding species, although not so deeply and the sides of the incisions are more nearly vertical. The appendages are short; the superior at first cylindrical then apically divided by a deep groove extending obliquely across it, the upper branch is wide, apex rounded, in profile somewhat wedge shaped, the lower is pointed and recurved downward and inward. The inferiors are stouter, longer, bifid, the upper stouter branch is pointed, the point reaching the grove in the superiors, the lower is smaller situated on the inner side of the former and points downward.

The appendages of the female are very short and blunt, the valves short and broad, dark in color.

This species is not common but has a wide range.

Argia apicalis, Say.

Length: of abdomen ♂ 31, ♀ 30; of hind wing ♂ 23, ♀ 25.

The male is pale blue with black marks as follows: Antennæ, vertex, prothorax except a blue spot each side, inferior humeral, mid dorsal carina, dorsum of 1-6 (the same extends on 3-6 as an apical ring) and the whole of 7. There are basal light rings on 3-7 and an imperfect mid-dorsal on 1-6

The female is light brown until fully adult, then as blue as the male. Her markings differ slightly: the inferior humeral is small or wanting, there is more black on the abdomen, the legs are paler, and the pterostigma lighter.

The superior appendages of the male are short; in profile they are narrow, end rounded, within there are two long teeth, the inner longer, obtuse, the outer acute, they are turned downward and outward toward the inferiors. The inferiors are much longer and stouter, equally bifid, the lower branch conical, the upper stouter, more pointed.

The female appendages are light in color, of the usual form. The species is not uncommon on the rocks along the larger streams. In no other of our species are the sexes so nearly similar.

Argia sedula, Hagen.

Length: of abdomen ♂ 26, ♀ 26; of the hind wing ♂ 18, ♀ 20.

The male is black, marked with deep blue. The frons, clypeus, labrum, postocular spots, the sides of the prothorax and a spot each side of its dorsum, antehumeral stripes, the sides of the thorax (divided by a black line on second suture) stripes on femora and tibiæ (pale like sides of thorax) the sides and apex of the first abdominal ring, the sides, two basal dorsal spots on two, basal rings on 1-7, the whole of 8-10 and sides of 3-7. The wings are slightly fumose, pterostigma light brown.

The female is clay colored and light olive, differing totally in appearance from the male; her wings are a little more fumescent and the stigma lighter.

The superior male appendages are longer than those of the preceding species, and are somewhat curved within, the ends are rounded with a pointed tooth on the lower inner angle and another on the

outer side acting as a stop as it impinges against the edge of 10. The inferiors are much longer, strongly bifid; the upper branch smaller, rounded, the lower stout, directed downward and backward, the edges are strongly denticulate, and the apex acute.

The appendages of the female are rather long and slender, the valves narrow, light colored.

The handsomest of our *Argias*, is rather common along larger streams in the southern part of the state.

ERYTHROMMA, Charpentier.

The single North American species of this genus occurs sparingly in this state; indeed it may be considered as rare.

Erythromma conditum, Hagen.

Length: of abdomen ♂ ♀ 28; of hind wing ♂ 20, ♀ 23.

The general color is black in both sexes, marked with blue and yellow in the male, as follows: blue, front of head (except postclypeus) labium, anterior border and spot on sides of prothorax, a wide humeral sinuous within, a mid-band on sides and thorax, stripes on the femora and tibiæ, the sides and apical rings on 1 and 2, interrupted basal rings on 3–7, and the whole of 8 and 9; yellow, labium and posthumeral (pale,) and the sides of the metathorax (bright). The female differs in having more black and paler blue on the head, the sides of the thorax with more and deeper yellow, the blue humeral narrower and paler, the first abdominal has a small square basal, black spot with sides and apical ring blue, the dorsum of 2–10 black, except the interrupted basal rings.

Pterostigma of both sexes yellowish brown. Posterior border of the prothorax in ♂ entire, in ♀ with five small lobes.

The superior abdominal appendages of the male are as long as 10; somewhat thicker at base then excavated within, curved inward at apex, which ends in a sharp point; in profile it is slightly narrow at base, and apically decurved. The inferiors are shorter in profile, wedge shape, from above broadened within at the end, making the outline securiform. The appendages of the female are slender, pale; the valves are short and narrow, also pale.

NEHALENIA, Hagen.

This genus consists of few and elegant species, perhaps none of the family are more beautiful. Three are known within the limits of the United States; two of these occur abundantly in Ohio.

The two species differ as follows:

Metallic green and blue........................*irene.*
Bronze, black and yellow........................*posita.*

Nehalennia irene, Hagen.

Length: of abdomen ♂ 20, ♀ 21; of hind wing ♂ 13, ♀ 15.

Metallic green marked with yellow or yellowish white as follows; post clypeus, genæ, borders of the labrum, labium, underside of head, sides of thorax posteriorly, under sides of abdomen, and narrow interrupted basal rings on 3–6. An apical spot on 8 the dorsum of 9 and 10 blue. The legs are whitish with black lines; tarsi ringed. Pterostigma pale yellow.

The female differs from the above in having the yellow a little deeper, and that on the sides of thorax, and

abdomen somewhat broader. The sides of 9 and 10 are bluish, there is more or less of an apical spot on 8 and the posterior border of 10, both blue. The green on 7-10 both sexes is obscured with blackish.

The posterior border of the prothorax of the male is faintly lobed; on either side there is a shallow sinus and in the middle a broad process with its upper border sinuate. That of the female has three large, round lobes, subequal. the middle rounder

The posterior border of 10 is excised, denticulate in the male. The superior appendages are very short, black, with two branches; the upper outer one is broad, obtuse, hairy; the lower more cylindrical, slenderer, apex obtuse; these branches are somewhat twisted on each other like the parts of the beak of the cross bill; the lower branch appears to be movably articulated to the upper. The inferior appendages are a little longer, turned upward and inward ending in a black denticle. The female appendages are short, thick, cones, yellow; the ovate valves are yellow with black processes.

It occurs about cool springs and streams of cool quiet water in mid-summer.

Nehalennia posita, Hagen.

Length: of abdomen ♂ 19, ♀ 19; of hind wing of ♂ 12, ♀ 14.

Blackish bronze marked with bright yellow or greenish yellow. The anterior border of the frons, base of antennæ, genæ, anterior half of labrum, under parts of head, humeral stripe which is interrupted, sides of thorax, anterior border and sides of prothorax, legs, under parts and sides of abdomen, apical ring on 1, basal rings on 2-7, and geminate basal spot on 9 yellow.

The postocular spots are round and greenish yellow; the second lateral suture is black; there are also black stripes on the legs and rings on the tarsi.

The female has the marks a little paler than the male.

The tenth segment of the male is short, posterior border with a forked upturned process. Superior appendages very short, yellow, thick above, a tooth at the superior angle (upper branch), the organ then turns downard and inward, becoming thin below and ending in an obtuse angle. The inferior appendages are about the same length, arise from a thick base, then narrow to a hand-like termination, the fingers of which are represented by five corneous denticles. The appendages and valves of the female are yellow, the processes short and dark.

This pretty species appears early and remains until late in September. It is abundant throughout the state.

AMPHIAGRION, Selys.

This is a genus of one species; one that ranges from equatorial America, at least as far north as Lake Erie and on the Atlantic Coast to Maine. In central Ohio it is extremely common about runs from springs. It occurs throughout the state.

Amphiagron saucium, Burmeister.

Length: of abdomen ♂ 18, ♀ 17; of hind wing ♂ 14, ♀15.

Red and dull black. Male, top of head black, anteclypeus, genæ and labium red, under parts of head, thorax and legs pale reddish, the latter with or without faint black lines; upper part of prothorax and thorax black; pterostigma reddish; segments 1-6 wholly red, 7 partly, the rest entirely blackish. Female, head as in the male except the black gives place to reddish on the rear; thoracic dorsum with a

broad stripe of black abdominal rings 3-9 with more or less black apically above, 10 reddish. All colors paler.

The posterior border of ten in the male has a deep round sinus; the appendages are about equal to 10, the lower longer than the superior; the superior has the upper branch prismatic, short, ending within in a stout denticle; the lower branch is finger-like in profile, turned down, obtuse, from above the two are lyre-shaped. The inferiors have a thick base and taper to an obtuse angle, sides straight. Both are rufous. The female appendages are short cones, rufous, the valves narrow, pointed, the processes short and rufous.

It is not unusual to find examples of females much larger than the average given above.

ENALLAGMA, Charpentier.

This genus comprehends moderate sized species of singularly varied and beautiful colors and our fauna is comparatively rich since thirteen species have already been captured within the state. They appear to take the place occupied by Agrions in Europe. Several of these charming and abundant forms appear early in the season, and representatives of the genus are abroad until late in September.

The species may be arranged in two groups or divisions on obvious characters, as follows;

1. Males with an apical spot* on the dorsum of the second abdominal ring; female with the dorsal band the entire length of 2.

2. Dorsum of 2, in both sexes, with a band; in the female 10 is blue or green.

*Individuals in certain species of this division have this spot covering much of or the whole of the dorsum of 2, but anteriorly it is always narrow

FIRST DIVISION.

The species of this group are all blue or green and black, or greenish and pale when teneral. They have three antenodal cells (Selys) and can be most easily separated by the character of the abdominal appendages of the male seen in profile:

(1). Superiors with two equal branches, separated by a deep rounded sinus; inferiors as long.................................*ebrium.*

(2). Superiors as long as 10, the upper branch long, stout, decurved apically, lower very short directed downard; the slender inferiors reaching the lower branch of the superiors *aspersum.*

(3). Superiors longer than 10, the upper branch more slender than in *aspersum*, the lower directed downards and inwards: the inferiors reaching nearly one third of their length beyond the lower branch of the superiors............................*traviatum.*

(4). Superiors exceeding half of 10, broad, excavated at distal extremity, sinus occupied by a large, pale, tubercle, lower angle (branch) prominent...*civile.*

(5). Superior appendages similar to the last, a little shorter, less wide apically in profile, the lower angle not so prominent *carunculatum.*

(6). Superior appendages short, wedge-shape, slightly curved upward at apex; inferiors decidedly longer, upper edge straight, *hageni.*

(7). Superiors relatively somewhat longer than in the last, base thick, apex turned down and within; inferiors slightly exceeding them...*geminatum.*

(8). Superiors short, upper branch short, distally rectangular, lower branch longer, directed upwards, obtuse; inferiors as long as upper branch...*doubledayi.*

SECOND DIVISION.

The species are blue and black (*exsulans and divagans*) and orange or green and black (*signatum*, *pollutum* and *fischeri.*)

They are separable as in the former group by profile view of the male abdominal appendages.

(1). Superiors half as long as 10, two branches, upper thick, lower longer, slenderer, sinus deep; inferiors acute, as long as upper branch of superiors...*exsulans.*

(2). Superiors less than half of 10, scarcely divided, upper part thick and rounded, lower slender directed downward; inferiors a little longer...*divagans.*

(3). Superiors more than half of 10, two widely divaricate branches, the upper thicker, slightly longer; inferiors a little shorter than the inferior branch of superiors................*fischeri.*

(4). Superiors longer than 10, end obliquely truncate with a tooth (lower branch) at outer third; inferiors slender........*signatum.*

(5). Superiors shorter than 10, securiform; inferiors as long as lower angle of superiors, very slender........................*pollutum.*

Enallagma ebrium, Hagen.

Length: of abdomen ♂ 25, ♀ 23; of hind wing of ♂ 17, ♀ 18.

The male is bright blue marked with black. The occiput, vertex, antennæ, and postclypeus are black; occipital spots large ovate and connected, the prothorax has a line on sides, posterior border and an ovate spot each side blue; thorax with a broad mid-dorsal, humeral and greater part of legs black; black on abdomen as follows: square basal spot on 1, apical spot and ring on 2–6 (these spots are successively larger, pointed anteriorly and occupy from one fourth to one half of the dorsum of the joints), the whole of 7 and 10, and the appendages. The female differs in the ground color which is yellowish green, the black markings of head and thorax are similar to those of the male, the legs are lighter, the pterostigma is light yellow, the entire thoracic dorsum is black except interrupted basal rings on 2–7.

The superior male appendages from above are divaricate, curved toward the middle-line and have a pointed hooklet just before the end within; in profile bifid, the upper branch straight, stout, obtuse; the lower narrower curved down then up making the sinus broad and rounded. The inferiors are as long as the superiors, curved slightly upward and inward, they are blue at base then black.

The female appendages are stout, about the length of 10, pale and the valves including the process yellow. The black sternal line includes the ventral spine of 8.

This species is exceedingly abundant along the marshy borders of Lake Erie. Common in June, by the end of July pretty rare. The female oviposits among floating *Utricularia*, algæ and stems of aquatics.

Enallagma aspersum, Hagen.

Length: of abdomen ♂ 25, ♀ 24; of hind wing ♂ and ♀ 18.

Male, blue and black; head black, front and rear blue, there is a black line at the base of the labrum and a broader one between the frons and clypeus; prothorax black, sides posterior border and triangular spot each side the dorsum blue; thorax blue with a moderately wide mid-dorsal and humeral stripe black; tarsi black, legs striped with black and pale blue; pterostigma black; abdomen blue with much black as follows: basal quadrate spot on dorsum of 1, a shield-formed apical one on 2 with apical black ring in connection with it, apical two thirds of dorsum of 3, entire dorsum of 4–6 except narrow interrupted basal rings, basal half of 7 and dorsum of 10. Female has the blue lighter, large ovate occipital spots, more black on the front of head, prothorax with very little blue, dorsum of 1–10 more or less black, apical blue ring on 1, basal interrupted ones on 2–6, large oblong blue patch covering basal two thirds of each side of dorsum of 7, and much smaller ones similarly placed on 8. Pterostigma lighter.

The superior appendages of the male are black divaricate, nearly as long as 10, curved inwards with an internal hooklet before the obtuse end; in profile the upper branch has the end rounded obliquely and capitate; lower branch short, directed downwards and backwards, apexes turned inwards. Lower appendages directed upwards, as long as the lower branch of superiors. The appendages of the female are black cylindrical, ends obtuse; the valves are narrow, pale, with the processes black.

This pretty species has been taken on the herbage about ponds, and flying over water, in central and northern Ohio in May and July.

Enallagma traviatum, Selys.

Length of abdomen ♂ ♀ 24; hind wing ♂ 17, ♀ 18.

Male blue and green. Head green, sometimes appearing blue, black as follows: stripe connecting the bases of the antennæ and the anterior ocellus, a stripe behind the ocelli produced laterally and divided on a level with the antenna sending one branch to the antenna and another to the compound eye, this latter is continued backwards along the margin of the eye and returned on the posterior part of the head and so surrounds the postocular spot on each side; a stripe conecting the ocelli, a dash in front of the anterior ocellus and a small point each side on labrum. Thorax with a mid-dorsal stripe composed of three fine lines and a humeral stripe, black. Legs pale, in most specimens a black line on the outer side of all the femora, abdomen blue, dark green as follows; an angular dorsal spot on 1, a patch strongly widened posteriorly and an apical ring on 2, whole dorsum, strongly narrowed or interrupted at base, on 3–7, a triangular basal patch on 8 and the whole dorsum of 10. In dry specimens these colors become faded and their outlines are hard to follow. The superior appendages of the male are much like those of *aspersum*, but are slightly longer and narrower; the inferior branch on each side is produced downward and inward towards the middle line so that the apices are separated only by about the width of the superior branch. The inferiors protrude about one third of their length beyond the apices of the inferior lobe of the superiors.

The female is colored similar to the male, but the following are noticable differences. The three fine black

lines forming the mid-dorsal thoracic stripe are separated by pale yellow, the dorsal patch on 8 is longer, reaching more than half the length of the segment, and the whole dorsum of 10 is blue.

The males are separated from those of *aspersum* by coloration of the abdomen. In the latter species one-half of 7 and all of 8 and 9 are blue, while in *traviatum* only 8 and 9 are blue.

The females of *aspersum* have a blue patch reaching three-fourths the length of 7 on each side, and a round spot on each side of the base of 8, blue, while *traviatum* has 8, 9 and 10 blue with the exception of the dark green basal patch on 8.

The species has been taken at Cincinnati (Dury) and at Akron in June. Seemingly common in various parts of the State.

Enallagma civile, Hagen.

Length: of abdomen ♂ 26, ♀ 28; of hind wing ♂ 19, ♀ 21.

The male is blue and black. Head with blue, as follows: large postocular spots, genæ, transverse stripe on frons below, clypeus except a black line at base of post-clypeus and labrum; the prothorax has the posterior edge blue; the legs are striped with pale blue and black, the tarsi faintly ringed with dark at distal ends of joints; pterostigma dark brown; abdomen with black as follows; square dorso-basal spot on 1, apical shield and ring on 2 occupying half the dorsum, apical third of 3–5, half of six, all of 7 except basal interrupted ring and the dorsum of 10 including the appendages.

The female differs in having the blue ground color usually paler, some individuals remaining with the pale or brownish teneral color, more black on the head, and the dorsum of all the abdominal segments black.

The male abdominal appendages from above are about the length of 10, divaricate, compressed, obtuse with a small denticle before the end on the inner side; in profile wider apically excavated, lower angle, (or branch) prominent, nearly as long as the upper slightly decurved branch, projecting from the apical excavation is an ovate, pale tubercle, the organ is slightly constricted at the middle. The lower appendages are curved upward, attaining the lower angle of the superior appendages.

The female appendages are rather long cylindrical, pointed; the valves ovate narrow, processes black.

This beautiful species appears to occur throughout the state and to be common in June especially south.

Enallagma carunculatum, Morse.

Length: of abdomen ♂ 27, ♀ 27; of hind wing ♂ 20, ♀ 21.

This species closely resembles the preceding so closely, indeed, that both have stood under one label in the cabinets of specialists for years until Morse separated them by naming and defining the present species in 1895. Now that the differences have been pointed out, the wonder is that experts could have united them. The females are distinguished with more difficulty than the males.

The males are separated readily, first by dorso-abdominal spots and second by the abdominal appendages. In *carunculatum* the apical black on rings 2–7 covers two thirds their length, in *civile* only one third; again the superior appendages are shorter, less compressed, hence more nearly cylindrical, the apex less spreading so that the tubercle which occupies the sinus is not so broad vertically, the tubercle is different in shape being narrow and curved like a new moon with rounded ends, and it lies in a grove on the inner lower face of the appendage.

Carunculatum is equally or even more abundant than *civile* especially in the northern parts of the state where lakes and reservoirs abound. It has been noted in myriads about Mercer county reservoir and at Sandusky Bay in July. At the latter place *civile* becomes common and practically disappears while *carunculatum* is numerous. It remains late in the season after most other species of the genus have disappeared.

Enallagma hageni, Walsh.

Length: of abdomen ♂ 13, ♀ 24; of hind wing of ♂ 16, ♀ 17.

The male is blue and black; head black above, while the genæ, labrum, anteclypeus lower border of frons, and long and narrow postocular spots are blue; prothorax black with posterior edge pale blue, mid-dorsal and humeral stripes black; legs bluish, femora and tibiæ black outwardly, tarsi dark at the articulations, pterostigma black. The dorsum of abdomen is black, as follows: a square basal area on 1; a round apical with ring on 2, apical one-third on 2–4, one-half of 5–6, all of 7 except interrupted basal ring and all of 10, including the appendages.

The tenth ring of the male is deeply excavated, the superior appendages are half as long as 10 depressed, quadrangular seen from above, apical side slightly concave with a soft tubercle projecting slightly beyond, making the outline somewhat convex, inner side with broad process at base, then concave to the angle which projects slightly inward, the outer angle is slightly rounded. On the upper surface there is a diagonal ridge from the inner apical angle; the inferiors are longer than superiors and forcipate; in profile the depressed superiors are curved upwards somewhat apically; the inferiors are straight on the upper border, apex slightly up-curved, lower border first convex, then concave then

The male abdominal appendages from above are about the length of 10, divaricate, compressed, obtuse with a small denticle before the end on the inner side; in profile wider apically excavated, lower angle, (or branch) prominent, nearly as long as the upper slightly decurved branch, projecting from the apical excavation is an ovate, pale tubercle, the organ is slightly constricted at the middle. The lower appendages are curved upward, attaining the lower angle of the superior appendages.

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The male is blue and black; head black above, while the genæ, labrum, anteclypeus lower border of frons, and long and narrow postocular spots are blue; prothorax black with posterior edge pale blue, mid-dorsal and humeral stripes black; legs bluish, femora and tibiæ black outwardly, tarsi dark at the articulations, pterostigma black. The dorsum of abdomen is black, as follows: a square basal area on 1; a round apical with ring on 2, apical one-third on 2–4, one-half of 5–6, all of 7 except interrupted basal ring and all of 10, including the appendages.

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convex. The surface of both appendages are tuberculate, more marked on the inferiors.

Hageni has been taken in few localities and always about ponds and "cat holes"; it must be regarded as uncommon or rare.

Enallagma geminatum, Kellicott.

Length; of abdomen ♂ 20, ♀ 19; of hind wing ♂ ♀ 15.

Male. Head: labrum and brows blue, clypeus and vertex black, post-ocular spots cuneiform, not connected, blue; prothorax black edged with blue, scarcely bilobed. Thorax black above with a blue stripe each side (this is sometimes divided as in *N. posita*); sides blue with a black line on the suture. Wings hyaline, pterostigma black; legs black and pale, tarsi black. Abdomen brassy black, blue as follows: 1, apical ring and a lateral spot connected with it; 2, a basal ring interrupted dorsally, this ring is sometimes very wide and the interruption also, there is a lateral stripe connected with the ring; 3-6, basal interrupted rings; 8-9, wholly; abdomen beneath pale blue with brown shades apically; the abdominal appendages are black, agreeing very closely in form with those of *divagans;* they are relatively stouter, and from above the outline is more oblong; there is a sharp tooth on the lower edge of the inner face, the upcurved apex of the lower branch (referring to the type *exsulans*) is a little stouter, and more obtuse than in *divagans*, while the upper one is a little less prominent; the inferior appendages are a little longer than the superior with the acute apex curved upward and inward.

Female. Very similar to the male. The blue of the front of the head of the male is pale blue or brownish; the post-ocular spots and humeral stripes a little paler; the abdomen is black above, the sides pale blue,

sternal membrane black; there is an apical ring on 1; 3 –7 have a basal pale blue ring with a wide interruption dorsally; on 8 there is a large blue spot on either side, these are separated dorsally by a black line of varying width; the appendages are black, the valves pale or faded brown.

This pretty and smallest species of the genus in our area is abundant from the latter part of May until well into September; it occurs in all parts of the state and has been taken from New York to Illinois. The females are often as deeply colored as the males. Both sexes may be fouud in the warmest part of the day flying low over floating herbage.

The female oviposits very much like *Ischnura verticalis* among algæ and debris at the surface of still water.

Enallagma doubledayi, Selys.

Length: of abdomen ♂ 25, ♀ 24; of hind wing of ♂ 17, ♀ 18.

The male is blue and black. Head black with lower part of face blue, a black line on clypeo-frontal suture; prothorax black, posterior edge blue, thorax with usual mid-dorsal and humeral black stripes, legs with blue and black, tarsi black, pterostigma black; abdomen much like that of *hageni:* first ring with small basal patch on dorsum, on 2 a shield-formed one with apical ring, 3–5 with apical one third black, 6 two thirds, all of 7 and 10.

The female differs from the male as follows; on the thorax and head she is yellowish, where the male is blue, her legs are pale with the apical half of the femora blackish outwardly and her abdominal segments are green above.

The abdominal appendages of the male are short projecting beyond 10 equal to half of its length; the superiors arise from a broad oblique base, become

narrower (more abruptly and deeply on the inner side) then expand to a broad, truncated slightly concave termination, a pale, depressed tubercle projects beyond giving a convex outline, the inner angle of the chitinous part is acute and slightly recurved; cephalad of this angle the anterior end of the obliquely placed, compressed, pale tubercle projects at an obtuse angle: in profile the appendage has the upper and lower sides nearly parallel, the end truncated at nearly a right angle with edges rounded, the tubercle projecting below and beyond making the outline rounded and projecting upward beyond the upper truncation. The inferiors are light at base, black at apex, rather slender shorter than the superiors, directed upward, base broad concave or sinuous below.

The appendages of the female are dark brown, conical.

The species has been taken at Columbus in May.

Enallagma exsulans, Hagen.

Length: of abdomen ♂ 27, ♀ 26; hind wing of ♂ 18, ♀ 20.

The male is bright blue and black. The head is black above with wedged-shaped, connected postocular spots blue, face blue with post-clypeus and a transverse band at base of labrum black; prothorax black with transverse line in front, the sides, spots upon the posterior border, a triangular spot each side of the dorsum, and a geminate oblong one between them; thorax blue with wide mid-dorsal, and humerals black, legs black with pale stripes, tarsi pale with dark rings; pterostigma brown pale edged. Abdomen slender, blue with black on the dorsum as follows: much of 1, a narrow band on 2 widest apically, the whole of 3–7, except interrupted apical rings, a narrow band on 8 not reaching the apical border, and on 10 often much narrowed posteriorly. The female is green and black; head and pro-

thorax marked as in the male; the humerals have a bright brown stripe through the middle covering both sides of the suture; legs paler; pterostigma yellow; dorsum of abdominal segments 1–8 black with apical rings 2–7, segments 9 and 10 are blue with two triangular, basal, black spots on 9, or nearly as often with a single spot covering from one third to two thirds of the top of the ring.

The border of 10 in the male has a bifid process above; the abdominal appendages are black, about half as long as 10, bifid, hairy; from above the sides of the upper branch are nearly parallel, obtuse, outer angle rounded, inner acute and recurved, the lower branch thicker, longer, obtuse, smooth; in profile both branches are obtuse, the upper shorter, the whole with the appearance of a clumsy hand of a cray fish.

The inferiors are black, curved upwards, shorter than the lower branch of superiors. The appendages of the female are very short, conical, blue; the ovate valves and processes are pale.

Exsulans is one of the most common and graceful species of the *Agrions*. It occurs everywhere, from June until September about all sorts of water living and stagnant.

Enallagma divagans, Selys.

Length: of abdomen ♂ 23, ♀ 24; of hind wing ♂ 16, ♀ 19.

The male is blue and black. Head black, blue, as follows: narrow, ovate connected occipital spots, front except post-clypeus and base of labrum; prothorax black with anterior lobe blue, a triangular blue spot each side of the dorsum of the posterior lobe and a dot of blue on the posterior margin; thorax black with narrow parallel stripes,—one each side, legs blue and black, pterostigma dark brown with lighter borders.

Abdomen slender, blue, dorsum black as follows: narrow band on 1 and 2, whole dorsum of 3–7 and 10, except narrow basal blue rings on 3–7. Female differs slightly, blue paler or greenish, legs paler, pterostigma yellow, humerals black with a bright brown streak along the suture (narrower than in *exsulans*), dorsum of abdominal segment 1–8 black, a large basal spot on 9 black, the whole of 10 blue.

The posterior margin of 10, in the male, with two processes above; appendages black, short, upper branch swollen, small process on inner upper angle, from the outer side below arises the lower branch which is slender, incurved, directed downward and bears a light cushion on the inner surface; the lower appendage is slender, acute, arises from a wide base longer than the lower branch of the superiors. The female appendages are short cones, black; the valves pale.

This species appears to be rare in most parts of the state.

Enallagma fischeri, Kellicott.

Length: of abdomen ♂ ♀ 24 mm.; hind wing, ♂ 17 mm.; ♀ 19 mm.

Male black, orange, green and blue. Labrum, anteclypeus, genæ and frons orange; the labrum has three black points at base; vertex, occiput, upper part of eyes and antennæ black; cuneiform post-oculars connected and greenish blue; head below pale yellow. The prothorax is black above, with orange or green, as follows: anterior lobe with a broad transverse line, middle lobe with a geminate spot in the center and a larger spatulate one each side, the posterior lobe with three small spots below and on sides pale orange. The "thorax" bronze-black with dorsal carina (sometimes only anteriorly) and humeral stripe bright orange; the legs yellow, with a black line on the outside of the femora and tibiæ (these lines are lightest on the hind pair).

The wings are hyaline, pterostigma small, reddish brown. The abdomen is slender, yellowish-green; dorsum of 1-8 and 10 bronze-black, 9 blue, sides and below yellowish-green anteriorly and bluish posteriorly; the tenth segment is prolonged and bifid to about the same extent as in *Enallagma exsulans*; the superior anal appendages are one-fourth shorter than 10, black, bifid, the upper branches divaricate, curved inward and bearing a minute hook at the inner distal angle; the inferior branches are stouter, shorter, obtuse, converging with a slight curve outward the inferior appendages are yellow, tips blackish, they turn outward and upward so that the tips rest in the forks of the superiors.

Female.—Head as in the male, except that the colors are less vivid; prothorax and thorax are similar except the mid-dorsal carina is more strongly marked with yellow; pterostigma lighter; abdominal dorsum is wholly bronze-black, although somewhat narrowed on 1, 2, 9, and 10, below greenish-yellow, ventral spine on 8 prominent, valves yellow.

Fischeri is an abundant and elegant insect, occuring throughout the state in the early part of summer.

Enallagma signatum, Hagen.

Length: of abdomen ♂ 28, ♀ 27; of hind wing ♂ 18, ♀ 20.

The male is dark yellow and black. Yellow on the head as follows: narrow, parallel, connected occipital spots, frons, clypeus and lips—there is a black point at middle of base of labrum and some irregular patches of same on postclypeus—prothorax black with sides, posterior border, a spot each side and a geminate one in the middle line yellow; thorax yellow with wide bronze black mid-dorsal and humeral narrowest above; legs and pterostigma yellow. Abdomen yellow marked

with black on the back of 1–8 and 10, basal yellow rings on 1–7.

The male abdominal appendages yellow, tips black, longer than 10, compressed; from above sides parallel, end round internal tooth; from side upper line straight lower divergent, shortest, hence the end is obliquely truncated with tooth at lower angle; inferiors slender curved inwards, much shorter than the superiors.

The female has the same general colors, usually a little paler; the post-clypeus is all black, the legs are yellow but have narrow black stripes; the dorsum of rings 1–9 are black, 10 yellow, sometimes the apex of 9. The slender appendages are all yellow, valves and processes the same.

Signatum is very numerous about canals, slow rivers and ponds.

Enallagma pollutum, Hagen.

Length of abdomen ♂ 29, ♀ 29; of hind wing ♂ 19, ♀ 20.

Male bright yellow, greenish yellow, pale blue and black. The occipital spots are long, narrow, connected greenish-yellow; the frons including the autennæ and rings or half rings about the ocelli, face and lips, except two transverse black lines in the postclypeus and three points at base of labrum yellow; prothorax yellow below and on sides, top black with large anterior spot, one on each side, another double one in the middle and the posterior edge yellow; the thorax is yellow with black mid-dorsal and a narrow humeral with irregular edges, the humeral is sometimes a mere brown stain; the legs are yellow with spines and rings on tarsi and claws dark brown. Abdomen attenuate wider posteriorly, dorsum black as follows: 1, except apical yellow ring, all of 2–8 except basal bluish ring on 3–7 (9 is blue), 10 with a cross of black, the rest blue.

The abdominal appendages are yellow, brownish above and at tips, about the length of 10. In profile the superiors are securiform; on the upper side curved upwards, truncated obliquely from below upwards and extended downwards at lower angle; from above the outer side is nearly straight, the inner concave, end obtuse with a projecting edge before the end on the inner side, inside below there is a cushion-like process exceeding the posterior edge making the same convex, this process turns forward and ends in a free curved piece resembling a halfclosed hand. The inferiors are slender curved inwards, much shorter than the superiors.

The female has the same colors as the male, although the yellow is not so bright, the head is similar marked; the yellow areas and spots of the prothorax are larger; the thorax has a mid-dorsal black stripe, the humeral suture is black with a brownish wash on each side but no real humeral stripe, the femora have a dotted line and a solid line of black, the tibiæ have an interrupted black line. Abdominal rings 1–9 are black dorsally with the usual interrupted basal rings; all of the dorsum of 10 and the posterior margin of 9 are bluish.

The conical appendages are dark and the valves and processes light.

Pollutum is exceedingly abundant along borders of marshes, on shores of Lake Erie and the larger interior lakes.

ISCHNURA Charpentier.

Three species of this genus occur in Eastern America,—*ramburii* along the Atlantic coast, *prognatha*, Virginia and *verticalis* everywhere. Only the last has been detected in the state. These forms are small, characterized by unlike pterostigma on the fore and hind wings, that of the fore wings is darker than the other but it reaches the costa, a fact which separates the present genus from the next.

Ischnura verticalis, Say.

Length: of abdomen ♂ 20, ♀ 21; of hind wing ♂ 13, ♀ 15.

These measuremeuts are averages of a series, but individuals are found which are much larger and others that are smaller.

The male is green, bronze, black and blue. The top of head, post clypeus, base of labrum and antennæ are black, the rest green including the round occipital spots; prothorax black with anterior edge and sides green; dorsum of thorax black with narrow green stripes each side (sometimes interrupted as in *N. posita*) the rest green, legs greenish with black stripes on femora and tibiæ, tarsi and claws ringed with brown; pterostigma of fore wings brown, hind wings light yellow. The abdomen is green below and on sides extending as interrupted basal rings on 2–7; the dorsum of 1–7 and 10 are otherwise black; 8 and 9 are blue with a lateral half band on each black. The posterior dorsal edge of 10 has a bifid upturned process; the superior appendages are black above, depressed, turned downards and inwards, expanded apically, the angles rounded especially the inner; the inferiors are longer, light below, black above, curved inwards; in profile they are bifid, the upper branch short and erect, the lower slender straight.

The females are of two forms (a) black and green (pruinose) (b) orange and bronze black.

(b) Top of head, postclypeus, base of labrum black, anteclypeus greenish. rear of head orange including the large connected ovate occipital spots which are confluent below with orange of rear of head. Thorax as in male, bright orange taking the place of green. Legs yellow with narrow stripes on tibiæ, and rings on tarsi and claws black. The 1 and 2 are all orange except more or less of an apical ring, 3 orange except a narrow dorsal band on posterior two thirds. All the others

greenish yellow on sides and black on dorsum; valves and short appendages, orange, processes black.

(a) Pale green and black as in male, the whole covered with a bluish bloom; the apex of dorsum of 2–7 darker, 8–10 darker, appendages and valves pale, processes blackish. Pterostigma on all wings light yellow.

Verticalis is without question the most abundant and ubiquitus species. It is one of the first to appear and one of the last on the wing in the fall. It may be found about all sorts of water courses and ponds.

ANOMALAGRION, Selys.

There is but one species in the genus and that is American occuring in both North and South America. It has been found in many quarters of the state.

Anomalagrion hastatum, Say.

Length: of abdomen ♂ 18. ♀ 20; of hind wing ♂ 10, ♀12.

Male is black and yellow; the head is black; yellow as follows: minute occipital spots, genæ, base of antennæ, front, anteclypeus, labrum, except black line at base, and the underparts; prothorax black with yellow broken lines on the borders; thorax black with two narrow white lines, yellow on sides and below, legs yellow black half stripe on femora, traces on the tibiæ. Pterostigma of anterior wings are ovate, on hind wings black rhomboidal. Abdomen is yellow, black bronze as follows: dorsum of 1-3, basal lance shaped and apical shield-shape spots of 4 and 5, the whole of 6 and basal half of 7.

The posterior margin of 10 has a long bifid spine.

The appendages are half as long as 10, yellow; superior appendages from above bifid, inner branch broad rounded, outer narrow, straight, pointed,

longer; the inferiors are stout, curved upward and inward, black at tip.

The female orange and black, head black and orange, pattern as in the male except the rear is orange; prothorax black with light lines on margin, sides orange; thorax orange with a wide mid-dorsal spot black; pterostigma light yellow; abdomen orange black as follows: small triangle in middle of 1, same at base of 2, rings at apex of 2-4, all of 5-8, basal triangles each sides of 9. The appendage and valves orange, the extreme tips of the processes black.

THIRD SUB-FAMILY.

GOMPHINÆ

This group includes species of strong individuality, their form and habits are unlike those of other groups.

The rigid spike-like abdomen, rather small and separated eyes are characters that define them without mistake. Among them are our bulkiest species, none are really small. Their habitats are various: some are found only about the rapid streams or waved tossed lakes, others by the reedy pools, while others haunt the sloughs mantled by lily-pads. They do not fly about in apparent sportiveness as do the *Libellulas*; the females rest among the adjacent foliage, or on the ground in some near by pathway; repairing at intervals to the water's edge, or skimming the roughened surface of the rapid stream or disturbed lake for oviposition; the males rest nearer the water, skirt the bordering aquates, or explore the water far from shore in search of the ovipositing females. Copulation is at rest in low herbage or high up in trees. The female oviposits unattended by the male and the eggs are washed from the tip of the abdomen by repeated dips into the water, either in some

quiet nook among the weeds or in other species far out on the rough surface of swift stream or wind disturbed lake. Most species fly in early summer, some in mid, and a few late in summer.

The genera represented may be defined and separated as follows:

I.

Median lobe of the labium bifid.

A. Basilar space free; triangles of front wings crossed; females with genital valves. (Legion, *Petaluria*, Selys.)

1. Triangles of the front wings with the upper side longer than the inner, outer longest; superior appendages of the male much widened beyond the middle; pterostigma very long, *Tachopteryx*. (Not yet taken in the state.)

II.

Median lobial lobe entire.

Basilar space free; female without genital lobes.

B. A part or all of the triangles crossed, membranule small or wanting. (*Legion Gomphoides*, Selys).

1. Legs long, hind femora reaching to the apex of 2; triangles crossed; internal and supra triangular spaces free.........*Hagenius*.

C. Triangles and supratrianuler spaces free; membranule very small or wanting. (Legion Gomphus Selys).

1. Inferior appendages bifid, branches nearly contiguous, straight, up-curved at apex...*Ophiogomphus*.
2. Inferior appendages of the male bifid, branches divergent; superiors but little longer than 10, divergent. Vulvar lamina considerably shorter than 9.
   (1). Hind femora of moderate length with many short spines, *Gomphus*.
   (2). Hind femora long (reaching apex of 2) spines many with an inferior row of 5–7. Much longer than the rest, *Dromogomphus*.

HAGENIUS, Selys.

There is only one known species in North America; this is fairly common, at least in Northern Ohio. It prefers the borders of sluggish streams and bayous.

Hagenius brevistylus. Selys.

Length: of abdomen ♂ and ♀ 55–60; of hind wing ♂ and ♀ 48–52.

The male is black and yellow. Head yellow, black as follows: occiput (rear yellow), vertex, base of frons antenæ, lines between frons and clypeus and at base of labrum. There is a stout vertical cone each side; the occiput is convex with a marginal fringe of black hairs. Prothorax relatively small with a geminate spot in the middle posteriorly; the dorsum of the thorax is black with yellow marks; semi-collar, short mid-dorsal carina, narrow curved line each side, narrow humerals; the sides are yellow with two parallel black bands in the middle separated by a yellow line, the latter interrupted at the metathoracic stigmata; the last thoracic is posteriorly edged with black. The legs are black, coxæ with yellow spots. The wings are slightly flavescent, costa yellow to the pterostigma which is long 5 mm., yellowish, covering 6–8 cells. The abdomen is black with a mid-dorsal yellow band on 1–8, more or less interrupted at apex of 3–7, on 8 there is a large basal trowel shaped triangle; the sides of 1–9 are yellow; 8 and 9 are slightly expanded laterally; the yellow on side of 8 occupies the entire length, on 9 it is lunate, shorter than the ring.

The abdominal appendages are shorter than 10, black. The posterior border of 10 is straight, superiors wide apart, slightly curved inwards, outer angle rounded, apex obtuse; in profile the upper border is curved downwards, apex prolonged in a sharp spine, anterior to it near the inner border there is another shorter and stouter one, and on the outer edge near the base there is a downwardly and outwardly directed process. The inferiors are united, broad, apex slightly excavated, apex directed upwards.

The female is very similar; 8 and 9 are considerably expanded laterally; appendages black, as long as

10; vulvar lamina covering one-fourth of 9, black, apex excavated, angles sharp.

OPHIOGOMPHUS, Selys.

There are several closely related forms of this group of elegant species. One only has been captured within our limits. It occurs in early summer about swift water of larger streams, usually flying with and in a similar manner to *Gomphus fraternus* and *G. externus* in parts where these occur.

Ophiogomphus rupinsulensis, Walsh.

Length: of abdomen ♂ 40, ♀ 38; of hind wing ♂ 30, ♀ 32 mm.

Bright yellowish green and pale brown. Face and occiput green, the latter slightly sinuous each side, cilia long and black, vertex blackish, vesicle straight, slightly swollen at the ends, antennæ black; thorax with a narrow pale antehumeral not reaching the shoulder, humeral complete and similar in width and color, sides uniformaly yellowish-green, also the legs except the knees, inner surface of tibiæ and tarsi which are blackish; wings hyaline, costa green, veins black, pterostigma brown, covering four or five cells. Abdomen slender, 8–9 strongly dilated; brown with elongated yellow spots on dorsum of 1–10, conspicuous on 2 and 10, ears on 2 yellow, large yellow spots on sides of 7–9.

Abdominal appendages yellow; superiors longer than 10, stout hairy, obtuse, somewhat divaricate curving towards the mid-line, under surface with black tubercles; inferior not so wide, a little shorter, obliquely truncated; in profile strongly excavated before the apex, a stout process directed upward at outer angle of the truncation.

Female similar in color, but differing as follows: vertex lighter, humerals fainter and the dorsal spots

on abdomen less sharply defined. The abdomen is stout 8 and 9 somewhat expanded; the appendages are long, yellow, acute; the vulvar lamina nearly as long as 9, divided to the base, branches nearly cylindrical, pointed, apexes bent outward and upward, clawlike.

It has not been taken later than June 20 in Central Ohio.

GOMPHUS, Leach.

This genus is well represented in our fauna; fourteen species have been taken and a few more are sure to be added in the future.

Baron De-Selys has arranged the species in groups defined as follows:

I Group, (Indian).

II Group. Front of thorax with six broad black bands; 7, 8 and 9 much dilated; membranule moderate. Anal appendages of the male black.

III Group. Front of the thorax yellow with six lines or bands, more or less broad; segments 7, 8 and 9 somewhat dilated; membranule very small; anal appendages black, superiors as long as 9, inferiors almost as long.

IV Group. Front of thorax olivaceous, with 4 or 6 lines or bands, brown, more or less distinct; segments 7 and 8 moderately expanded; anal appendages yellow or light brown, superiors as long as 10, inferiors nearly as long.

V Group. Front of thorax with an interrupted, mesothoracic semi-collar and two cuneiform spots (stripes) yellow; sides yellow with two black rays, confluent at two points; pterostigma short, black; face mostly black; anal appendages brown, superiors longer than the 10th segment.

VI. Group. Front of the thorax black with two antehumeral wide bands and a superior antehumeral

point yellow; sides yellow with a black, interrupted band; face yellow; anal appendages yellow, as long as 10.

VII. Pterostigma long; front indented, front of thorax brown with two isolated, narrow, straight lines, a vestige of a humeral and a mesothoracic semi-collar interrupted in the middle all yellowish green; abdomen long, slightly dilated posteriorly.

Our species are distributed in these groups as follows:

II. dilatatus and vastus,
III. quadricolor, fraternus, externus and graslinellus,
IV. villosipes, furcifer, exilis, lividus and spicatus,
VI. spiniceps and plagiatus,
VII. notatus.

The species may be separated with little difficulty by the following characters.

II.

1. Large, male abdomen 50 mm; face yellow with two narrow transverse black bands..*dilatatus.*
2. Medium, male abdomen 38 mm.; face yellow with two broad transverse black bands..*vastus.*

III.

1. Dorsum of 9–10 black..(1) and (2).
2. Dorsum of 9–10 with a yellow band..........................(3) and (4).

(1). Small, male abdomen 32 mm.; no yellow on dorsum of 8, *quadricolor.*
(2). Medium, male abdomen 38 mm.; yellow triangle on dorsum of 8 (sometimes a faint yellow band on 9............ ....*fraternus.*
(3). Medium, superior abdominal appendages of the male slender, obliquely truncated and excavated at apical fourth......*externus.*
(4). Medium, male superior appendages stouter, obliquely truncated with a prominent tooth at outer angle...................*graslinellus.*

IV.

1. Medium size, male abdomen 35 mm.; antehumeral stripes slightly divergent below.

(1). Superior male appendages yellow, truncate with inwardly directed spine at the inner distal angle.

(a). Male and female occiput with a spine in the middle.....*villosipes*.
(b). Without the occipital spines..*furcifer*.
(2). Superior appendages brown, pointed, an acute tooth representing the outer distal angle.
(a). From side view the male superior appendages have a strong, acute tooth near the middle of the inner, inferior edge, *spicatus*.
(b). From side view the male superior appendages have obtuse prominence near the apex of the inner, inferior edge........*lividus*.
2. Small, male abdomen 30 mm.; antehumeral more divergent below.
(1). Face yellow, occiput straight..*exilis*.

VI.

1. Large, black, 9 long..*spiniceps*.
2. Large, brown, 9 slightly longer than 8.........................*plagiatus*.

VII.

1. Large, brown and yellow...*notatus*.

Group II.

Gomphus dilatatus, Rambur.

Length: of abdomen ♂ 50, ♀ 47; of hind wing ♂ 40, ♀ 40.

Male black and yellow; head yellow, the following black: borders of labrum and vertical line in the middle, a transverse line between clypeus and frons, the vertex antennæ; and the vertical vesicle is straight, occiput rather narrow, convex with a fringe of black cilia. The prothorax black, sides yellow with a large geminate spot centrally of the same: the thorax is yellow, black as follows: a mid-dorsal stripe with parallel sides, not reaching the front margin, an ante-humeral and humeral —both widely separated by a narrow yellow line and two lines on the side; legs black with coxae and under side of fore tibiae yellow; the wings are hyaline, costa yellow; pterostigma moderate covering five cells, yellow surrounded by heavy black veins. The abdomen is black, yellow as follows: sides of 1–2, dorsal band on 1–4, lanceolate apical spot on 5–7, large triangular apical spot on side of 8 and oblong one on side of 9.

The ears on 2 are yellow, edges black; joints 3–6 are slender, especially 3.

The appendages are black divaricate; the superiors as long as 10, slender, acuminate, apex obliquely truncate on outer distal fourth, there is a minute tubercle at beginning of the obliquity, in profile arched; the inferiors equally spreading nearly as long, up turned at the apex.

Female similar; vulvar scale elongate, of two lamellæ which are narrower towards the end and turned outwards.

This fine species has been taken only in the central part of the State in June. It is evidently rare. One male is known in which the triangles are all one crossed.

Gomphus vastus, Walsh.

Length of abdomen ♂ and ♀ 38; of hind wing ♂ and ♀ 23.

Male black marked with greenish yellow. Head with yellow, as follows: occiput, except the extreme edge, two spots at rear of eyes, frons in the middle, anterior half of postclypeus, labrum on either side, the genæ and the lateral lobes of the labium. The occiput is slightly concave. Prothorax black with yellow front edge, spot each side and in middle of posterior edge; thorax with yellow semicollar, upper half of carina, antehumerals, narrow humerals and sides, on the latter there is a black line in the front of the stigma and one at the second lateral suture. Legs and feet black with anterior femora yellow on the outside. Pterostigma brown covering four or five cells; costa green on extreme edge, the fore wings slightly flavescent on basal fourth. The abdomen is slender 7, 8 and 9 very much expanded laterally; shiny black with pale olive mid-dorsal interrupted band on 2–7; this is broad and halberd-shaped on 2, narrow and basal on 3–6, basal triangle on 7, the apical edge of 7 is bright

yellow, also a spot on basal edge each side of 8 and the whole lateral expansion of 9, the dorsum of 1 and the sides of 1 and 2 are light green.

The appendages are black, a little longer than 10; the superiors from above are divaricate, base broad, gradually narrowing with the apex obliquely truncated making the inner angle acute; in profile they are arched with a tooth at outer angle of the apical truncation, apex slightly turned upward. The inferiors reach the truncation of the superiors, a little more divaricate, apex turned up and obtuse.

The female differs in having a small black thorn either side of the vertical vesicle, the abdomen a little stouter, the mid-dorsal more distinct, 7, 8, and 9 not quite so much dilated and the spots at base of 8 faint. The appendages are cylindrical acuminate, black, longer than 10; the vulvar lamina longer than half of 9, bifid for one third its length, branches acuminate, approximated. This is an exceedingly common odonate along the shore of Lake Erie.

The females fly far out over the waves dipping the abdomen in the water as they fly to wash off the eggs. During June and early in July they may be found on any sunny shore of the lake or bays. They capolate at rest in trees and shrubs.

GROUP III.

Gomphus quadricolor, Walsh.

Length: of abdomen ♂ and ♀ 32 mm; of hind wing ♂ 26, ♀ 27 mm.

Male black and yellow. Face and occiput yellow; vertex black; vertical vesicle slightly excavated in the middle, occiput very convex. Prothorax black or dark brown with yellow spots on the sides and middle; dorsum of the thorax brown, mid-dorsal carinae in part yellow also a broad ante-humeral and a narrow humeral, sides yellow with two well marked oblique

bands narrow; coxae yellow, legs black with little pale on the inside of the femora; costa yellowish, pterostigma light brown covering three cells on fore wings. Abdomen slender, moderately expanded at 8 and 9, and four on hind wings black, yellow as follows: sides of 1 and 2 including the ear like appendages, expansion of 8 and 9, dorsal band from 1–8–broad on 1 and 2, narrow, lanceolate, apical, very small triangle on 8.

The superior appendages of the male are black, longer than 10, pointed with the apex directed outward; in profile there is a broad expansion downward with a backwardly directed tooth near outer third. The inferiors are nearly as long, more divaricate and turned upward at apex.

The female is stouter, occiput less strongly convex, vertex lighter, more pale or even olive on femora, dorsal band less pronounced, expansions on 8–9 slight not so bright yellow. The appendages are conical and black; the vulvar lamina is exceedingly short, emarginate, lobes round and thick; the posterior border of 8 is thickened and emarginate so there are four rounded bodies at this level.

This pretty species has been taken in Central Ohio late in May and as late as June 15. It rests on rocks projecting from rapids on the banks near by the most rapid parts of large streams.

Gomphus fraternus, Say.

Length of abdomen ♂ and ♀ 38; of hind wing ♂ 31, ♀ 32.

Male black and greenish yellow, Head; occiput yellow, strongly convex, fringed with black hairs, rear black, yellow at border of eyes, vertex and antennæ black, the whole face yellow, labium brownish. Prothorax black, bright yellow anterior edge, olive spot each side and two geminate ones in middle above. The thoracic carina is yellow with narrow black, parallel,

band each side not quite reaching the anterior border of mesothorax, a broad black antehumeral separated except at one point above from the narrower humeral by a yellow line; sides yellow with second lateral suture black and a band below reaching the mesothorac stigma a little above; wings with the costa green; pterostigma brown, covering three or three and a half cells; legs and feet black. The abdomen with well marked dorsal yellow band on 1–8, a broad space on 1, three lobed on 2, narrow, extending nearly the whole length of 3–6, on 7 half as long as ring, on 8 small triangle; the sides of 1–2 yellow, on the lateral expansions of 8 a large bright yellow spot separated from an apical one by irregular brown shade, and all of the sides of 9.

The appendages are blackish, longer than 10, from above divaricate, base broad, tapering, apex acuminate, in profile arched, apex obliquely truncated upward; inferiors more spreading, reaching beyond the lower angle of the truncation which is slightly prolonged, apex turned upward, obtuse.

The female differs in having the occiput concave with an obtuse process in the middle, the humeral and ante-humeral connected for a wider space, a yellow stripe on outer side of first femur and sometimes on third; the abdomen is stouter, and the expansion of the apex not so broad. The appendages black and pointed; the lamina reaches the middle of 9, bifid in apical third, branches turned outwards at apex.

Fraternus is common in most parts, in May, June, and first days of July; it is only found by the shore of the great water or by considerable streams, then about the most rapid reaches. The females oviposit by washing the eggs into the rapids or the breaking waves.

Gomphus externus, Selys.

Length: of abdomen, ♂ 40, ♀ 40; of hind wing ♂ 34, ♀ 35.

Male black and greenish yellow. Head; occiput not at all or slightly convex, yellow fringed with black hairs, rear black with a stripe proceeding downward from the occiput and outer border yellow, vertex black with a small spot on each side below the occiput yellowish green, antennæ black, whole face yellow, margins of mouth brownish.

Prothorax black, anterior border bright yellow, above with a spot each side and a geminate spot between, yellowish. Thoracic carina yellow with a black band each side, interrupted anteriorly, a broad, black antehumeral separated below from the humeral by yellow, first and second lateral sutures and an abbreviated line between them reaching nearly to the metastigma black, remainder of thorax greenish yellow; costa green, pterostigma brown covering about four cells, legs black with the exception of the anterior femora each of which have a greenish yellow vitta on the inner side. Dorsal band of abdomen yellow as follows, a patch broadest behind on 1, broad and three lobed on 2, broad at base, gradually narrowed but not reaching the apex on 3–6, a triangular basal on 7 and 8, reaching the whole length of the segment on 9; laterally sides of 1 and 2 and part of 3, partially obscured spots on base of 4–7; a basal and a small apical spot on 8, whole length of 9, yellowish. Appendages longer than 10, from above divaricate, tapering gradually from base, outer distal angle obtuse, inner distal angle acuminate, apex obliquely truncate, from side arched; inferiors nearly as long as the superiors, apex turned upwards.

The appendages of this form are very much like those of *fraternus*, but the superiors have a more prominent outer distal angle and the inner distal angle is not so strongly produced.

The female has the occiput straight, not "rising in the middle in two confluent curves" (Walsh), nor is

"the space between the lateral thoracic lines livid," but of the more usual greenish yellow hue ; the vertical thorns are black and conical ; the posterior femora are either with or without external vittæ, in this regard agreeing with the female of *fraternus*. t has been said that the latter has no vertical thorns, and that the females of *externus* and *fraternus* may thus be separated ; this will not do, for the female *fraternus* has long slender, black or yellow vertical thorns ; they are easily separated, however, by the difference in the occiput—*fraternus* with a spine in the middle of the border, *externus* having the same straight or slightly concave—*externus* is larger and the vitta ♀ is almost as conspicuous as in *externus*.

Easily separated from *fraternus* by the wide yellow vitta on the ninth abdominal segment, its larger size and straight or concave occiput.

Common along the Olentangy river at Delaware and Columbus in June.

Gomphus graslinellus, *Walsh*.

Length of abdomen ♂ and ♀ 39, of hind wing ♂ 33, ♀ 34.

Male black, yellow and greenish yellow. Head; occiput yellow, slightly convex, fringed with short, black hairs, rear yellow with the upper parts of the orbits brownish or black, vertex and antennæ black. Prothorax black with a bright yellow spot on the anterior border, base with a spot each side and one between them yellowish; thoracic carina brown with a similar colored space each side, humeral and antehumeral bands present, separated for their whole length by a narrow yellow stripe, first and second lateral sutures margined with brown; wings with the costæ greenish yellow; legs, femora and tarsi black, tibiæ black with a yellow dorsal band as follows : a rather wide, uniform band on 1 and 2, a narrower,

tapering patch on 3–6 in no case reaching the apex, a triangular, basal patch on 7 and 8, a wide vitta widening gradually as it approaches the apex on 9 and an elongate spot on 10; laterally segments 1, 2 and base of 3 are greenish yellow, 4–7 have obscure basal patches, and 8 and 9 have the lower border wholly bright yellow. Superior appendages brown, from above divaricate, sides nearly parallel, outer distal angle nearly a right angle, inner distal angle produced into an oblique acuminate process, apex slightly concave; inferior appendage nearly as long as the superior, spreading, curved upward and inward at the tip.

The female is stronger, abdominal segments 8 and 9 are not so strongly dilated, the front femora are yellowish vittate below and the occiput is concave with a prominence in the middle; appendages pointed, dark, the lamina is short.

Separated from *fraternus* by the wide vitta on 9, and from *externus* as well as *fraternus* by the greenish yellow stripe on the superior side of all the tibiæ.

The species flies in central Ohio during June and the first part of July. Four pairs taken in this locality are in the University collection.

Group IV.

Gomphus villosipes, Selys.

Length of abdomen ♂ 38, ♀ 39; of hind wing ♂ 31, ♀ 33.

The color is black, olive, yellow, and brown. In the male the rear of the eyes is yellow below, black above; occiput yellow, extreme edge black, cilia black; convex, stout, black, spine in the center; vertex black, end of the vesicle yellow; whole front and lips yellow. Prothorax black, yellow spot on sides and double one in middle of second lobes, yellow spot in middle of third

lobe. Thorax light olive, black, marked as follows; stripe each side the carina not forming a collar, an antehumeral and humeral well separated, a line in front of the stigma and the upper part of the second suture; the legs are black yellow as follows; inside of femora of first pair, narrow stripe on external side of tibiæ of all pairs; wings with costa olive, pterostigma yellow. The abdomen is black with olive dorsal band on 1–7, 8 and 9 all brown lighter on the sides, moderately dilated, sides of 1–7 more or less oli e, 9 yellow including the appendages,

The superior appendages are as long as 10, divaricate wide at base, tapering, outer apical angle rounded, inner produced into a long, black tipped spine set obliquely inward; in profile greatly curved, apical third directed obliquely upward. Inferiors with spreading apexes blackish, curved up at apex.

Female differs in being stouter and a little larger and in having more yellow on the sides of the abdomen. In one specimen the spine on the occiput is quadridentate above, the same organ in some males shows two similar teeth, while in others it is simply acuminate. The vulvar lamina is triangular, one third as long as 9 with the apex two parted, contiguous.

The species is on the wing at Columbus during the latter half of May and the first part of June.

Gomphus furcifer, Hagen.

Length: of abdomen ♂ and ♀ 36, hind wing 30.

Colors black, olive, brown and yellow. Male, occiput very slightly convex, olive and fringed with black hairs, rear of head yellow below, black above, whole face olive, mandibles and vertex black. Prothorax with an irregular, yellow spot near the front margin, posterior to this a lateral spot each side and two geminate spots on the vertex olive; mesothoracic carina olive bounded each side by brown which in some

specimens is obscure ; a humeral and an antehumeral present, usually united above ; first and second lateral sutures obscurely margined with brown. Dorsal line on abdomen present on 1–7, 10 nearly all yellow. Appendages yellow, spreading, shorter than 10, sides nearly parallel, outer distal angle prominent, tipped with a black denticle, inner angle produced into an oblique horn-like process, apex truncate, inferiors longer than the superiors, strongly divaricate, yellow, turned upward and black at tip.

The female has the vulvar scale short, triangular divided at the apex with the ends rounded.

Readily separated from *villosipes* by the male appendages, and by the absence of the spine on the occiput.

Taken at Licking Reservoir, June 14, and at Kent, June 21. Does not seem to be common.

Gomphus exilis, Selys.

Length : of abdomen ♂ 30, ♀ 32 ; hind wing ♂ 24, ♀ 26.

Colors black, olive, yellow and brown. Male occiput yellow or olive, straight and ciliate above, rear of head brown or brownish, front margin of prothorax yellow, posteriorly with an olive spot each side and a geminate one of the same color between them; brown each side of the thoracic carina, humeral and antehumeral bands present, more or less obscurely separated by olive, space between first and second lateral sutures brown, legs brown or black, all the tibiæ vittate with olive above, feet black; wings, costa greenish, pterostigma brown. Abdomen black, yellow dorsal band present on segments 1–9, segments 8 and 9 with ventral edges yellow, 10 wholly brown or with a small yellow marking dorsally.

Superior appendages as long as 10, divaricate conical, acute at apex, from side view a triangular process

may be seen on the under side ; inferiors shorter than superiors, divaricate and turned up at tip from side view.

The female differs in having the tenth segment wholly yellow, the legs, front pair femora yellow below and blackish above, middle femora the same, hind femora yellow except at apex, the coxae and trochanters of all the legs yellow. Vulvar lamina short, not more than a fifth as long as 9, triangular, divided, the two lobes separated with their apexes rounded.

This species is common in all parts of the state in the latter part of May, June, and fore part of July. It has been taken at Columbus as early as May 9th. Canals and ponds are its favorite resorts.

Gomphus lividus, Selys.

Length of abdomen ♂ 34–36, ♀ 36, hind wing ♂ 30–32, ♀ 34.

Colors fuscous, olive and yellow. Male, occiput convex, ciliated with black hairs, face yellow, vertex and antennæ fuscous, rear of head olive, largely overlaid with brown. Prothorax fuscous, front border, a posterior, geminate spot and a spot each side olive ; thoracic carina fuscous narrowly margined each side with the same color, humeral and antehumeral bands fuscous obscurely divided for part of their extent by olive, space between the first and second lateral sutures fuscous, as is an oblique band on the posterior margin of the thorax ; legs fuscous with the superior side of all the tibiæ and hind metatarsi marked with olive ; wings, costa olive, pterostigma yellowish brown. Abdomen, dorsal band present on 1–9, this band is abbreviated on 5–8, on 9 it is wide and continuous ; sides of 1–2 and 8–9 olive below, basal spot on 3–7 ; superior appendages brown, nearly one and a half times as long as 10, divaricate, widest at base, gradually tapering, outer distal angle has the appear-

ance of a small denticle, inner distal angle strongly concave; from side view an inferior prominence occupies the outer third. Inferiors more spreading than the superiors, of nearly the same length, and, from side view turned upward at the tip.

The female has the occiput straight, and the legs more olive than those of the male. This species may be easily separated from *villosipes* and *furcifer* by its fuscous instead of black color; and by the superior appendages of the male, which instead of the inner distal angle being produced into a process which points obliquely inward, as in those species, the prominence of this angle takes the general direction of the body of appendage. From *exilis* it may be readily separated by its color and larger size.

Gomphus spicatus, Selys.

Length of abdomen ♂ 35, ♀ 35, hind wing ♀ 27, ♂ 30.

Colors olive, brown and fuscous. Male; occiput olive, regularly convex, ciliated with black hairs on the superior margin: prothorax fuscous with the usual lighter markings. Mid-dorsal carina margined, each side with brown; humeral and antehumeral bands present, brown, obscurely separated by olive for at least part of their extent, space between the first and second lateral sutures brown, none of the brown markings on the thorax are as conspicuous as in the foregoing species of this group. Legs fuscous, all the tibiæ vittate with olive above; wings, costa yellow; pterostigma brown, covering four cells and part of a fifth. Abdomen, dorsal band present, segments 8-9 yellow on the inferior edge of the lateral surface. Superior appendages divaricate, as long as 10, wedge shaped with an acute projection near the middle of the outer border, apex acuminate. From side view, near the middle of

the inner margin is a prominent acute projection. Inferiors more spreading than the superiors, from side view gradually curved from base to apex. The female differs in having the occiput suddenly prominent in the middle and front femora wholly olive and hind femora olive with apex fuscous. The vulvar lamina is about one fourth as long as 9, divided lengthwise, the tips separated; so that it has the appearance of being composed of two wedge-shaped parts with acute apexes.

The slight contrast in the colors of the thorax, and the acute spine on the under side of the middle of the inner edge of the superior appendage of the male, are characteristics of this species.

Spicatus frequents the borders of wave beaten shores or rushing rivers; the males, during the warm sunny hours, make frequent excursions over the crested waves, after each of which they return to shore for rest, the females generally remain in the herbage or higher on trees near by, flying out occasionaly to deposit their eggs in the disturbed waters and often bringing back a consort to the place of rest.

A common species in parts of Northern Ohio in June.

Group VI.

Gomphus spiniceps, Walsh.

Length of abdomen ♂ 48, ♀ 47, hind wing ♂ 36, ♀ 39.

Male; colors black, olive and yellow; head black with an olive band on the post-frons. On the vertex there is a U-shaped elevation, the upper angles of which are tooth-like, and between this and the eye on either side there is a small yellowish spine ; occiput nearly straight, olivaceous above. Thorax and dorsum black with brownish reflection, mesothoracic

collar, a short. broad stripe each side and antehumeral ray, spatulate above, olive ; sides paler, with an olivaceous stripe beneath each wing, olivaceous below ; wings hyaline, veins and costa black, pterostigma reddish brown, 5 millim. long; membranule very narrow, whitish ; legs black. Abdomen black, 8 and 9 strongly dilated, 9 almost as long as 8+10 ; 1, 2, 8 and 9 olivaceous on the sides, 1–8 with dorsal yellow spots as follows : 1, apical, triangular ; 2, lanceolate, nearly the entire length ; 3, 4, 5 and 6, basal, oblong ; 7 and 8, basal, triangular ; appendages black, divaricate, superiors longer than 10, acute, depressed, slightly turned up at apex and having eight or ten minute crenulations on the lower, outer edge apically, inferiors not quite so long, hamulate at apex.

The female differs in the abdomen being much stouter, 8 and 9 not dilated and in the possession of a small notch in the middle of the occiput. The vulvar lamina is very short and rounded at the apex.

The species has been taken at Sugar Grove and Akron in September. Four specimens were captured and many more seen at Sugar Grove, September 4th, 1894. They were observed flying late in the afternoon, and ovipositing in a small brook that was rippling over pebbles. They continued to fly until it was so dark that the eye could not follow them. Pairs at rest; the female oviposits in a manner similar to that of the *Libellulas.*

Gomphus plagiatus, Selys.

NOTE—Regarding the identity of Ohio specimens which I believe to be *plagiatus,* at the present time, there is some doubt. This species and *notatus* are apparently very close. Dr. Calvert has kindly sent me specimens of *plagiatus* taken in Texas. A dozen specimens taken at Sandusky June 20, '96 and referred to by Prof. Kellicott in Jour. Cin. Soc. Nat. Hist. XIX,

66 as *notatus* agree with the above mentioned specimens of *plagiatus*. Mr. C. C. Adams who has studied the specimens of both species in the museum of Comparative Zoology recently states that the female of *plagiatus* has the vulvar lamina emarginated in the middle while the same is rounded in *notatus*. The Sandusky females agree with *plagiatus* in this regard.

Because of the doubt existing in my mind, I give Dr. Calvert's description of *plagiatus* in full below.

Olive green. Brown predominating on thoracic dorsum so as to leave a narrow antehumeral stripe, notably divergent from above downwards from its fellow of the opposite side, and the mid dorsal carina yellow (teneral) or green; sides pale, a line in front of the metastigma and on the second lateral suture, brown. Abdomen long, 1–6 brown with a pale green mid-dorsal spot or stripe, 7–10 yellowish.

Male: Hind margin of occiput slightly convex. Superior appendages with teeth, apex obliquely truncated (when viewed from above), the acuter angle on the inner side, usually no tubercle at the outer (obtuse) angle. Inferior appendages one-fourth shorter.

Female. Hind margin of occiput straight. Vulvar lamina very short, less than one-tenth of 9, emarginated in the middle, tips on either side of emargination acute.

Length of abdomen ♂ 40–45, ♀ 44–49; hind wing ♂ 32–35, ♀ 35.5–37.

Mr. C. C. Adams makes the statement that the females of *plagiatus* and *notatus* may be separated by the vulvar laminæ. This is emarginated in the middle in *plagiatus* and rounded in *notatus*.

One female specimen taken at Wauseon July 1, 1896, I am of the opinion belongs here. It measures as follows:

Length of abdomen 42, of hind wing 38 millimeters.

GROUP VII.

Gomphus notatus, Ramb.

Dr Calvert states that *Gomphus notatus* seems to differ from *plagiatus* according to specimens in the Museum of Comparative Zoology by its smaller size, slightly concave occiput (slightly convex in *plagiatus*) 8th segment of the abdomen dark brown with a mid-dorsal yellow triangular spot, (this segment pale brown in *plagiatus*) and no well marked external ante-apical angle on superior appendages as exists in *plagiatus*.

DROMOGOMPHUS, Selys.

Two species of this genus have been taken in the State ; *spinosus* is common in all parts, *spoliatus* is abundant in the Maumee Valley. The species when flying usually follow close to the banks of quiet streams and canals, and are not so fond of rippling water as are many species of the genus *Gomphus*.

The two species may be separated as follows :

1. Abdominal segments 7–10 almost entirely yellow, the distal part of hind femora black..*spoliatus*.
2. Abdominal segments 7-10 almost entirely black. hind femora all black..*spinosus*.

Dromogomphus spinosus, Selys.

Length : of abdomen ♂ 41 ♀ 42, hind wing ♂ 35, ♀ 37.

Male; colors black, brown, olive and yellow. Head; occiput olive, regularly convex, ciliated ; front olive with sutures margined with black ; vertex and mandibles black : Prothorax black, yellow dorsally ; mid-dorsal carina olive, a fine band each side uniting above and below with the antehumeral, a broad humeral and an antehumeral united above and below, brown, remainder of thorax olive ; legs and feet black, front

tibiæ vittate with olive beneath. Abdomen; dorsal band present on all the segments, sides of 1–2 and base of 3 olive, sides of 7–10 more or less marked with yellow, superior appendages black, from above wedge-shaped, acuminate at tip; from side view, tips slightly elevated, inferior appendages from above slightly more spreading than the superiors, gradually curved, from side view four fifths as long as the superiors, gradually curved, apex blunt.

The female differs in the stouter form of the abdomen, in the occiput being concave in the middle where it bears an angular tooth, and in the humerals and antehumerals being separated above.

The vulvar lamina is about a third as long as 9, triangular in general outline and divided at the apex with the two parts divaricate, pointed.

The species is distributed all over the State.

The female has been observed often ovipositing in a manner similar to *Maccromia illinoisensis*, that is by skimming the water and every few feet or rods touching it with the abdominal tip, scarcely checking her speed; at other times I have seen them drop down from an overhanging tree and repeatedly tap the water, remaining in one place after the manner of *Libellula*. Pairs were noticed to fly up into tree tops and remain in union for a considerable time.

Dromogomphus spoliatus, Selys.

Length of abdomen ♂ 45, ♀ 47, hind wing ♂ 36, ♀ 39.

Male; colors brown, yellow and black. Head; occiput yellow, convex, ciliated with light colored hair, face yellow, vertex brown; prothorax yellow irregularly marked with brown, mid-dorsal carina yellow, margined each side with brown which gradually widens anteriorly, humeral and antehumeral bands present, separated; first and second lateral sutures and

more or less of the space between them brown, remainder of the thorax and all the coxae yellow; legs and feet, all the tibiæ and tarsi, front femora except an inferior, yellow vitta on each, middle femora and distal part of hind femora, black; the hind femora have dark lines laterally and superiorly for their whole length; costa yellowish, pterostigma light brown covering four cells. Abdomen; dorsal line present on 1-6, sides of 1-3, basal, transverse band on 4-6, all of segments 7-10, yellow; segments 7-10 are often largely suffused with brown above and the extreme ventral edge is always brown in fully matured specimens. Superior appendages yellow, in form resembling those of *spinosus*; inferiors from above gradually divaricate, more spreading than the superiors, wide at base and gradually narrowed; from side view yellow at base, black distally, shorter than the superiors, suddenly turned up at apex and produced above into an acute projection.

The female differs in its larger size and stouter abdomen and in the occiput being rather suddenly prominent at the middle. This prominence does not form a spine as in *spinosus* but simply an obtuse angle. The vulvar lamina is nearly a third as long as 9, triangular in general outline, the apex is divided; the two parts divaricate, acuminate, and turned outward at the tips.

The species is common in north western Ohio along the Maumee River and its tributaries, and the Ohio Canal. I have never seen this species fly up into trees during copulation as is stated regarding *spinosus*. Both male and female fly along the bank with a swift, regular flight, coming to rest on bare spots close to the water where copulation takes place. The female oviposits similar to *Libellula*. The queer thing about this gomphid is that females are as often taken as males.

FOURTH SUB-FAMILY.

CORDULEGASTERINÆ.

The members of this sub-family are all large insects. Less than ten species have been described from America north of Mexico. None of these seem to be common, so far as individuals are concerned, at least they are not often taken. I have seen so few specimens on the wing that I do not feel justified in giving anything of their habits in the field.

CORDULEGASTER, Leach.

Two species have been taken in the state; they may be separated as follows :

1. Large species, abdominal segments 2-7 nearly encircled by yellow, *erroneous.*
2. Smaller species, yellow on abdomen takes the form of spear-shaped markings on the dorsum of segments 2-8............*obliquus.*

Cordulegaster erroneous, Hagen.

Length of abdomen ♂ 53–56, ♀ 62, hind wing ♂ 44–47, ♀ 50.

Female; colors black, brown and yellow. Head; anterior part of vertex, nasus, genæ, disk of labrum, and labium, yellow ; occiput yellow behind, brownish yellow in front, ciliated above with long yellowish hairs; remainder brown. Thorax; in front two oblique bands pointed below and abbreviated at both ends, on each side two oblique bands abbreviated at the ends, and a spot above between them, the posterior ventral surface and a spot between each pair of wings yellow. remainder black ; legs and feet black ; veins of wings and pterostigma black. Abdomen, a ventral and a lateral spot each side on 1, a transverse median band, oblique on the sides and continued by the ventral spots on 1, and a ventral and lateral spot distally

each side on 2; a median band and a small lateral spot distally on 3; a median band on 4–7 obscurely abbreviated above; and a triangular lateral spot each side on 8 yellow; remainder black. Vulvar lamina three times as long as 9, eight millimeters, wide at base, gradually narrowed with apex rounded, divided except at base, the two parts contiguous; appendages short, black, apex angular.

he male is colored similar to the female: superior appendages short, not as long as 10, two small interior teeth. Inferior appendages three-fourths as long as the superiors.

The female was taken, while resting above a cold spring on a hillside at Sugar Grove, July 5, 1891.

Cordulegaster obliquus, Say.

Length: of abdomen ♂ 52, ♀ 58, hindwing ♂ 44, ♀ 48.

Male; colors black, yellow and brown. Head; rhinarium, mandibles and posterior part of vertex black, eyes brown, remainder yellowish. Thorax; an antehumeral band widest above and abbreviated at both ends, two lateral bands with a row of more or less obscured spots, posterior part of venter, and a spot between each pair of wings yellow, remainder brownish-black. Legs and feet black. Costa yellow in front, veins and pterostigma black, Abdomen; a ventral spot each side on 1, a dorsal band and two lateral spots on 2, a dorsal and a ventral band on 3, dorsal bands in the form of spear-shaped spots on 4–8, yellow, remainder black. Superior appendages from above about three fourths as long as 10, slightly divaricate, sides nearly parallel, abruptly pointed at the apex; from side view straight, cut obliquely upwards at apex which is pointed and slightly elevated. Inferior appendages from side view about two thirds as long as

the superiors, straight, prominent at the outer distal angle and bearing a forward curving tooth.

The female is colored similar to the male.

Taken at Orwell, Ashtabula County, June 1895.

FIFTH SUB-FAMILY.

ÆSCHNINÆ.

The members of this sub-family found in Ohio are medium sized to very large insects. It includes some of the most hardy forms, being the first to appear on the wing in spring and the last to disappear in the fall. The eyes are contiguous for nearly their entire width in both sexes, wings are long and broad and the anal angles of the hind pair are rounded in the female and prominent in the male (except Anax). As a usual thing they do not spend so much time flying over the water as some of the preceding forms. They are common about fields and sunny places in woodlands, and are continually busy catching flies and other small insects for food.

The female is attended by the male much of the time and it is a common thing to see pairs take long excursions over the water, flying three or four feet above its surface. The female seems to prefer to oviposit in stagnant pools and ponds where the surface is covered by duck weed and other aquatic plants.

The genera may be separated as follows ;

1. Triangle once crossed.. *Gomphæschna*
   Triangle with more than one transversal.................................2
2. Subnodal sector furcate in the hind wings.................................3
   Subnodal sector not furcate in the hind wings.............................5
3. Anal angle of male rounded, thorax uniform green...............*Anax*
   Anal angle of hind wing of male acute, thorax brown, banded with green..4

4. Expanse more than 110 millim., abdomen of male and female not strongly constricted at three.......... ....*Epiæschna*
Expanse less than 100 millim., abdomen strongly constricted at three...*Æschna*
5. Fore wing broadest at the nodus, two lemon yellow spots laterally on thorax...*Fonscolombia*
Fore wing broadest at nodus, two whitish bands laterally on thorax .... *Basiæschna*

ANAX, Leach.

This genus differs from all other members of the *Æschninæ* in the male having the anal angles of the hind wings rounded. The species are very large and their flight is strong. *A. junius* is an exceedingly abundant form in all parts of the state. *A. longipes* has never been taken in Ohio, but Mr. Charles Dury is confident he identified the species on the wing at Cincinnati in May 1898.

The following table will serve to separate these two species :

1. Front above with a fuscous spot surrounded by green and the whole by blue...*junius.*
2. No markings on front above...*longipes.*

Anax junius, Drury.

Length: of abdomen ♂ 53–57 ♀ 53, hind wing ♂ 50 –52, ♀ 54.

Colors ; male, green, blue and fuscous.

Head; front green, a black spot above surrounded by green, then by fuscous; mandibles black, other mouth parts green ; eyes fuscous occiput greenish in the middle ; rear of eyes, superior margin and middle fuscous, lateral parts green

Thorax green ; femora brown, tibiæ and tarsi black; wings hyaline, costa yellow, other veins fuscous or brown ; pterostigma yellow, membranule large, white anteriorly, fuscous posteriorly. The base of the abdomen corresponds in color to the thorax, blue begins at the anterior third of the second segment and is more or less apparent on several segments, but

fuscous predominates, The colors are so changed in dry specimens that it is difficult to define their exact outlines. Male superior appendages as long as 9+10. From above gradually widening from base; inner border suddenly excavated near the apex; an acute spine at outer distal angle; a median, longitudinal thickening traverses the whole length of each appendage. Inferior appendage short about one sixth as long as the superiors, distal end truncate.

The female differs in having the occiput twice tuberculate posteriorly, and in not having so strong a constriction at abdominal segment three. The appendages are as long as 9+10, foliate, pointed at apex.

This species has been taken at Columbus as early as March 21st, and has been observed on the wing during the first days of November. It oviposits usually while attended by the male. The pair may be seen flying over stagnant water where sedges and the like abound; at intervals they drop down and alight on some object near the water's surface; soon the female may be seen with her abdomen beneath the surface of the water depositing her eggs. Nymphs of various sizes may be secured from ponds and ditches at most any time of year.

Anax longipes, Hagen.

Length of abdomen ♂ 55-58, ♀ 52-60, hind wing ♂ 51-53 ♀ 49-56.

The following from Hagen's description, Psyche 1890, Vol V, 303, will enable the student to identifiy the species:

Male, eyes dark reddish brown, head, thorax and base of abdomen green; abdomen brick red; front green, without any spot above; vertex, antennæ and occiput black; eyes behind with a very large, elongated green spot; legs black, femora yellow. Wings hyaline, venation black, costa yellow, pterostigma narrow, yellow.

Female, head, thorax, legs and the two basal segments green; eyes blue, the hind margin of the occiput on each side yellow; second segment with a transversal brownish median stripe on each side; abdomen from the third segment brown.

Hagen's description was taken from living specimens.

GOMPHAESCHNA, Selys.

The insects of this genus have been taken in the State only at Columbus. Either they are not common or we have not learned how to procure them, for but few speciments have been taken or even seen.

Gomphaeschna furcillata, Say.

Length: of abdomen ♂ 44, ♀ 41; hind wing ♂ ♀ 36. Male, color black and brown. Head, eyes brown, front brownish the posterior extremities in the form of a band grayish, disk marked with yellowish; antennæ yellow; behind the eyes black.

Thorax brown, a narrow humeral band and two lateral bands black; the first lateral band is abbreviated above, the posterior one is narrow and reaches to the base of the hind wing; between the inferior portions of the humeral stripes there are two yellow markings resembling marks of parenthesis. Femora brown, tibiæ and tarsi black; wings; costa yellow, pterostigma and veins brown. Abdomen black, the apex of each segment and ventral markings obscure brownish. Superior appendages as long as 9+10 inferior edge abruptly widened at basal fourth, both edges gradually widening from thence to apex, a longitudinal thickening at middle, apex rounded, inferior appendages two fifths as long as the superiors; the distal third divided, with the branches divaricate.

The colors of living specimens are very much brighter than in dry specimens. Thus what I have called brown or yellow is really greenish originally.

Taken at Columbus June 13.

This species differs from any other species of the sub-family in our fauna in the form of the abdomen. The widening again after the constriction at three is not present, but a very gradual narrowing continues from thence to apex.

FONSCOLOMBIA, Selys.

The single representative of this genus is quite common in Ohio. It flies along streams where fallen trees and drift-wood abound. Its glossy wings correspond so closely to the water that it is seen with difficulty. The female has been observed resting on the trunks and branches of trees and shrubs, sometimes twenty feet or more above the ground. This is one of the species which the collector is not likely to procure until he understands its habits. After that he considers it a common form.

Fonscolombia vinosa, Say.

Length of abdomen ♂ 50 ♀ 50. hind wing ♂ 42 ♀ 44.

Male; color reddish brown, darker in fully matured specimens. Two conspicuous yellow spots on each side of thorax; wings slightly brown at base, veins reddish, pterostigma yellow. Abdomen; mid-dorsal carina present on 2–8, auricles on 2 yellow, two or three small yellow spots usually present on sides of 4–8; superior appendages as long as 9+10, widest beyond the middle, narrowed from thence towards apex which is bluntly angular, a longitudinal, median thickening present.

Inferior appendages one third as long, yellow, conical, notched and brown at apex.

The female has the hind wing wider and the anal angle rounded.

Taken in all sections of Ohio in August and September.

BASIÆSCHNA, Selys.

The single species of this genus is abundant at times, while some seasons pass without its being observed at all. It is on the wing early, specimens having been procured at Columbus as early as the middle of April.

Basiæschna janata, Say.

Length: of abdomen ♂ ♀ 43, hind wing ♂ ♀ 36.

Colors; brown and fuscous. Male; front greenish, above yellow or greenish, with a median, longitudinal, impressed, black marking; occiput and rear of eyes largely yellowish. Thorax, mid-dorsal carina fuscous bordered each side by greenish; two greenish yellow bands edged with fuscous on each side; wings clouded at base, veins brown, pterostigma yellow, membranule white. Abdomen constricted at 3, superior appendages as long as 9+10, narrow at base, very gradually widening to beyond the middle. Here there is a bend and the general direction is directly backward, instead of obliquely downward and backwards as before. The apical third is flattened. Inferior appendages conical, one half as long as the superiors.

The female appendages are shorter, straight, and anal angle of hind wing rounded.

EPIÆSCHNA, Selys.

Like the two preceeding genera this one contains only a single species. It is the bulkiest dragonfly of our fauna. *Macromia taeniolatà* approaches it in expanse but not in size of body. This species differs from other species of the sub-family in the less obvious constriction at abdominal segment three.

Epiæschna heros, Fab.

Length: of abdomen ♂ 65 ♀ 67, hind wing ♂ 55 ♀ 60.

Male; colors brown and green. Front green darker approaching brown above, margin of mouth brown. Thorax brown, an antehumeral band and two lateral bands with a spot between their superior ends, green. Wings yellowish, veins and pterostigma brown; legs; femora brown at base, black at apex, tibiæ and tarsi black. Abdomen brown marked with bright green which becomes obscure in dry specimens; 10 with a mid-dorsal tooth.

Superior appendages, basal third narrow, remainder widened, median longitudinal carina present, inferior edge hairy. Inferior appendage one half as long as superiors, oblong, notched at apex.

The female lacks the spine on the dorsum of 10, but has a spined projection ventrally on that segment. She also has the rear of the eyes elevated so that a prominent projection is formed each side of the occiput.

The species flies during early summer. When on the wing it is continually catching insects, great number, of which are required to satisfy its voracious appetite. It is one of the few dragonflies that often enter buildings.

ÆSCHNA, Fabricius.

The species of this genus fly very commonly from August until the end of warm weather in the fall. In protected places along the edge of woods, one may find all of our Ohio forms flying together most any time in September. The different species are so much alike that one can not with certainty recognize them on the wing. Like the other members of this sub-family they take long excursions over sunny fields in search of flies and other insects for food. The three species of the genus taken in Ohio may be separated as follows:

1. Male, anal triangle of hind wing with three cells; a prominent spine at inferior distal angle of superior appendages. Female, genital valve strongly elevated at apex, vulvular process long, 2 millim..*constricta.*

2. Male, anal triangle with two cells; superior appendages with longitudinal carina not denticulated. Female, genital valve not strongly elevated at apex, vulvular process short..........*verticalis.*
3. Male, anal triangle of two cells; longitudinal carina of superior appendages with apical third denticulated..................*clepsydra.**

*We have not succeeded in identifying the female of this species.

Æschna constricta, Say.

Length of abdomen ♂ 52-58, ♀ 53-55, hind wing ♂ 43-46 ♀ 45.

Colors fuscous, brown and green. Male; front green, with a T-shaped black spot above; occiput yellow, lateral projections black; back of eyes black. Thorax brown with an antehumeral and two lateral bands green, also green between each pair of wings, femora brown above fuscous beneath, tibiæ and tarsi black; wings, pterostigma fuscous, membranule white anteriorly, dark posteriorly, anal angle of hind wings three celled. Abdomen fuscous, banded and spotted with green, strongly constricted at 3; superior appendages as long as 9+10, inferior margin prominent, hairy, and thickened to form an inward projecting tubercle posteriorly; base narrow, inferior distal angle produced into a prominent spine. Inferior appendages one half as long as the superiors, concave above, conical, blunt and obscurely notched at apex.

Female, wings yellowish, especially in o'd specimens, appendages foliate, mucronate at tips, narrow at base, length 7 millimeters; genital valve slightly longer than 9, with a lateral emargination; apex elevated truncate; vulvular process 2 millimeters long and tipped with a bundle of hairs. Description of female taken from three specimens taken in copulation.

This is our commonest *Æschna* and is taken in all parts of the state.

Æschna verticalis, Hagen.

Length of abdomen, 50-53 ♀ 53, hind wing ♂ 44-47 ♀ 45.

Colors brown, fuscous and green. Male; markings on thorax and abdomen are variable in different specimens. There are only two cells in the anal triangle of hind wings which at once separates it from *constricta*. Superior appendages as long as 9+10, narrow at base, superior longitudinal carina not denticulated, apex with a short thorn directed obliquely downward. Inferior appendage one half as long, conical, angular at apex.

Female of the same form as the male, appendages narrow at base, oblong, rounded at apex, obscurely mucronate. Genital valve as long as 9 with a lateral emargination; apex not strongly elevated. Vulvular process short, not over one millimeter. The appendages only a little more than half as wide as in *constricta*, This description was taken from a female taken in copulation. When more material is procured it may be necessary to verify some statments.

This species flies with *constricta* but is not nearly so common.

Æschna clepsydra, Say.

Length of abdomen, ♂ 51 ♀ 50, hind wing ♂ 44, ♀ 43.

Colors brown, fuscous and green. Head, front green, nasus and rhinarium fuscous or brownish in some specimens. Mandibles and margins of mouth fuscous, a fuscous T spot above; occiput yellow in the middle, remainder fuscous; rear of eyes fuscous. Thorax brown, an antehumeral stripe and two lateral stripes green, also green between the wings above; femora and tibiæ brown above, fuscous beneath, tarsi fuscous; wings and pterostigma fuscous above, yellowish beneath, costa yellowish, other veins fuscous; anal triangle of two cells, membranule small.

Abdomen constricted at 3, fuscous marked with green; mid-dorsal carina present; appendages as long

as 9+10, narrow at base, inferior edge widened at basal third, width nearly uniform from thence to near the apex; longitudinal carina present, denticulated on posterior third; apex rounded and furnished with a spine which points obliquely downward.

SIXTH SUB-FAMILY.

CORDULINÆ.

The members of this sub-family are medium sized to large species, and unlike those of the preceding, are seldom seen except in the vicinity of water.

All I have seen ovipositing fly leisurely near the bank and strike the water from time to time with the tips of their abdomens to wash off the eggs. Some of the forms fly quite early in spring but none of them are on the wing late in the fall.

The following will aid the student in separating our genera:

1. Hypertriagonal space free, sectors of the arculus free at origin...2
   Hypertriagonal space traversed, sectors of the arculus more or less united at origin............ 4
2. Hind wings with dark markings at least at base.........................3
   Hind wings without dark markings, colors metallic. *Somatochlora.*
3. Hind wings, dark only at base with triangles free...*Tetragonuria*
   Hind wings, dark at base, middle and apex, triangles traversed. *Epicordulia.*
4. Large species, expanse over 90 millimeters, tenth segment of the abdomen black in both sexes....................................... *Macromia.*
   Smaller species, expanse 70–75 millimeters, tenth segment light. *Didymops.*

MACROMIA, Rambur.

The members of this genus are easily rocognisable on the wing by the transverse yellow band of the abdomen. They are large species and fly from middle to late summer. Both males and females, in apparently

equal numbers, have been taken while flying over the surface of the water.

The following key will separate the species of the genus:

Expanse less than 100 millimeters, no antehumeral stripe *illinoisensis*

Expanse 110 millimeters or over, antehumeral stripe present *tæniolata*

Macromia taeniolata, Rambur.

Length of abdomen ♂ 58 ♀ 61, hind wing ♂ 52 ♀ 58.

Colors black, yellow and brown. Male; head large, front vertex black with two prominences above, frons metallic green with yellow spots superiorly, rhinarium fuscous; labrum olive, dark at middle and inferior edge A faceted tubercle on the posterior edge of eye. Thorax fuscous with a distinct greenish reflection; yellow superioraly, part of antehumeral and a complete lateral band present, yellow. The latter entirely encircles the thorax, passing between the insertions of the two pairs of wings above and the second and third pairs of limbs below. Legs and feet black, the hind femora reaching the middle of the 2nd abdominal segment. Abdomen black, with superior yellow markings on segments 1–8. Superior appendages 3–5 millimeters in length, bent inwards at apical third, apex turned outwards; an emargination on the outer side extends from the base to beyond the middle where it terminates in a small tooth. Inferior appendage nearly as long as the superiors, conical, curving upwards towards the apex.

Female usually larger than the male, and in my specimens the superior yellow markings on 8 of the male are not present.

Female usually larger than the male, and in my specimens, the superior yellow markings on 8 of the

male are not present. The species is common in the north western part of the state along the Maumee River. The males fly well out, and consequently are seldom taken, the females oviposit among leaves and algæ near the shore.

Macromia illinoisensis, Walsh.

Length: of abdomen ♂ 48-50, ♀ 50; hind wing, ♂ 45 ♀ 46.

Male; colors fuscous, brown and yellow. Head very much as in *tæniolata*. Thorax brown or fuscous with metallic greenish reflections. Yellow before the base of the anterior wings, and lateral band present as in the latter species, but the antehumeral absent.

Wing hyaline often brownish tinted, more prominently at the apex. Superior yellow markings, often very small, on abdominal segments 2, 3, 4, 7 and 8, occupying nearly a third of 7 at base. This last is strikingly prominent when the species is on the wing. Superior appendages much as in *tæniolata*, but more gradually narrowed towards the apex; slightly longer than 10. Inferior appendage about as long as the superiors, conical, apex elevated. Female differs in having superior yellow markings on segments 2–7 and the wings are often more uniformly brownish.

The species flies most commonly during July, and may be seen at times some distance from water. I have taken the female flying over ripples of our larger streams, and a pair in copulation resting on a low bush not over two feet from the ground. It is more common than the preceding species and may be expected in any part of the state.

Its smaller size will separate it from *tæniolata*.

DIDYMOPS, Rambur.

The single species of this genus is commonly taken in Ohio. We have found it most common in May,

although it has been taken as early as April 25. At this early date the species was found in sunny places along the border of woods.

Didymops transversa, Say.

Length: of abdomen ♂ 36-38 ♀ 40; hind wing ♂ 33-35 ♀ 37.

Male; colors brown and yellowish. Head, front livid with frons and nasus brownish, frons above with an olive spot each side; rear of eyes yellowish, dark near the occiput. Thorax brown, a transverse band before base of the fore wings. mid-dorsal carina, a narrow humeral and a prominent lateral stripe, white; wings brownish at base, costa yellow, pterostigma and veins fuscous; legs, femora brown, tibiæ yellowish above, fuscous below, tarsi black. Abdomen brown, all the segments more or less banded, a prominent whitish band at base of 7, and a spot each side at base of 8; 10 wholly whitish or yellowish.

Superior appendages 2 millimeters in length, widest at base, nearly straight, posterior third on the outer side narrowed, apex acute; inferior appendage about as long as superiors, edged with brown, conical, apex blunt and furnished superiorly with a pair of prominences.

Female larger than the male and the brown markings between costa and third vein at the base of the wings is noticeably longer.

EPICORDULIA Selys.

The two species of this genus are American. We have only one of these in Ohio. This one is common along all of our larger streams, canals, and lake shores during July and August.

Epicordulia princeps, Hagen.

Length: of abdomen ♂ 43 ♀ 47; hind wing ♂ 41 ♀ 45.

Colors; olive, brown and fuscous. Male; front olive, vertex brownish, antennæ black. Thorax thickly clothed with long, gray pile, ground color olive, anterior, lateral band prominent below, humeral and antehumeral bands present, but usually very nearly obscure. Legs, coxæ and trochanters olive, front and middle femora olive above, fuscous beneath, hind femora and all the tibiæ and tarsi fuscous. Wings with a basal patch, often greatly reduced on the front pair, a patch at nodus, sometimes wanting, and apex black. Abdomen constricted at 3, largely fuscous above; beneath and on the sides yellowish brown. Superior appendages club shaped in general outline; inferior, apical fourth excised, apex very bluntly pointed. Inferior appendage more than two thirds the length of the superiors, widest at base, gradually narrowing to apex, which is furnished with two upward directed projections.

Female similar to the male in color and form, vulvar lamina nearly as long as 9, divided for its entire length, the two parts divaricate, slightly curved inward at apex; appendages longer than 9+10.

The species is easily identified by the black markings on the wings, as none of our large forms except some of the Libellulas have such characters.

TETRAGONEURIA, Hagen.

Two species of this genus have been recorded for Ohio. These fly in the fore part of summer, and one is very common. Small ponds seem to attract these forms, but it is not unusual to find them flying over running water. They are the smallest species of the sub-family, *Cordulinæ*.

Tetragoneuria cynosura, Say.

Length: of abdomen ♂ 30, ♀ 27; hind wing ♂ 28, ♀ 29.

Male; frons, labrum and labium yellow, other parts of front olive. In some specimens the whole front is olive. Thorax with a covering of long pubescence, two angular, yellow spots in front of the inferior half of the second lateral suture, these spots and both sutures margined with metallic blue. Basal two thirds of front femora yellowish or light brown, remainder of legs dark brown to nearly black. Fore wings hyaline; hind wings with a basal streak between subcostal and median veins extending to first antecubital, the space at extreme base between submedian and post-costal veins and a triangular patch occupying the lower part of the anal triangle and part of at least three neighboring cells, fuscous; remainder hyaline.

The dark markings of the wings are variable, but in none of our specimens do they extend much beyond what I have indicated, they may be very much reduced however. Abdomen fuscous with yellow markings on the sides of segments 2-9. Superior appendages as long as 9+10, the apical two thirds (nearly) thickened. From above separated at base, gradually approaching one another for one half their length, then diverging to apex. Inferior appendage reaching the middle of the thickened portion of the superiors, oblong conical, expanded laterally at extreme apex.

Female vulvar lamina composed of two horn-like lobes whose apices reach beyond the extent of the ninth segment.

The species is a common one in all parts of Ohio.

Tetragoneuria semiaqua, Burm.

Length: of abdomen ♂ 26-27, ♀ 28; hind wing ♂ 25-28, ♀ 29.

This species is very close to *cynosura*. Color alone is used to characterize it. The fuscous at the base of the hind wing is much extended, and occupies nearly all the space between the base of this wing and a line

drawn from the anal angle to the fourth antecubital. Different specimens vary in this respect, in some the dark marking is slightly reduced while in others it is extended. This character is constant in Maine specimens, kindly loaned me by C. C. Adams, in New York specimens and in Indiana specimens, so that, in none I have seen is there necessity of confusion with *cynosura*.

Taken at Columbus and observed at Delaware, in May.

SEVENTH SUB-FAMILY.

LIBELLULINÆ.

Twenty-eight species of Ohio dragonflies fall under this sub-family. They are second to the AGRIONINÆ when number of species is considered, but are by far the most conspicuous forms of our odonat fauna in all situations, especially during the summer season. Stagnant pools and ponds, skirted by sedges, cat tails and water lilies are especially attractive to them. Here the males fly back and forth, catching small insects for food, and searching for the females. While pursuing this apparent pleasure many of them sacrifice their lives to satisfy the greedy appetite of the king bird who perches himself on a branch of a nearby tree where he can view the proceedings and swoop down whenever he is sure he can procure a dragonfly for his trouble. Presently at your feet you observe the female with wings almost motionless, waving up and down, and at each downward movement, striking the tip of her abdomen on the surface of the water. She is ovipositing. If with a water net a quantity of the debris near the bank be procured a dozen or more nymphs of various stages are usually included. Thus one might seat himself and write out nearly a full life history of a dragonfly from the material of a few minute's collecting.

The members of this sub-family are medium sized to large species with ample wings and short, thick bodies. In some species males and females are colored differently, while in others both sexes are alike. Most of the forms are easily collected on account of their abundance, but there are a few species that occur over large areas and are never common anywhere, these are usually procured with difficulty. The Ohio species are placed in ten genera which may be separated by the following table:

1. Hind wings very wide at base, fore wings, except in some cases at extreme base, entirely transparent..........3
2. Hind wings not extremely wide at base..........4
3. Base of hind wing black or brown for its entire width......*Tramea*
   Base of hind wing transparent with anal margin yellowish, or infuscated at anal angle..........*Pantala.*
4. Hind lobe of the prothorax large, bilobed..........5
   Hind lobe of the prothorax small, entire..........10
5. Sectors of the arculus pedicellate..........6
   Sectors of the arculus not pedicellate..........9
6. Both sectors of the triangle in the hind wings arising from its hind angle..........7
   Lower sectors of the triangle in the hind wings arising from its hind angle, the upper from its outer side..........8
7. Nearly black species, extreme base of hind wings black, front white..........*Leucorhinia.*
   Never black, extreme base, sometimes basal half, of hind wings yellowish brown, front variously colored but never pure white, *Diplax.*
8. Base of hind wings perfectly transparent, thorax unicolorous, last antecubital of front wings usually not continued to median vein..........*Mesothemis.*
   Base of hind wings yellowish brown, thorax banded with black and olive, last antecubital of front wings usually continued to median vein..........*Pachydiplax.*
9. Small species, expanse about 30 millimeters, hamule of male not bifid..........*Perithemis.*
   Larger species, hamule of male bifid..........*Celithemis.*
10. Male with a pair of ventral hooks on first abdominal segment, third tibiæ, as long as third femora..........*Plathemis.*
    Male with no ventral hooks, female with third tibiæ at least a little longer than third femora..........*Libellula.*

PANTALA, Hagen.

The two species of this genus are large with hind wings very wide at base. Abdominal segments 3 and 4 each with two additional transverse carinæ, nodal sector waved.

1. Front yellow, anal margin of hind wing yellowish.......*flavescens*.
2. Front red, anal angle of hind wing with a fuscous spot. *hymenæa*.

Pantala flavescens, Fab.

Length: of abdomen ♂ 32–34, ♀ 34; hind wing ♂ 40–42, ♀ 41.

Male; color yellowish brown. Front yellowish, margins of mouth, antennæ and basal part of vertex fuscous.

Thorax, mid-dorsal carina and vestiges of lateral bands present, fuscous; hind wing, anal margin and a small patch at apex flavescent. Abdomen with a maculate mid-dorsal band, sometimes absent on some of the segments. Superior appendages about 3 m.m. in length, yellow at base, remainder black, oblong, nearly contiguous, and furnished with an oblique spine at apex. Inferior appendage two thirds as long as superiors. Female like the male.

The species is a strong flyer and fully matured specimens are hard to take as they fly well out from the bank. Taken in all parts of Ohio during July and August.

Pantala hymenæa, Say.

Length: of abdomen ♂ 30-33, ♀ 31; hind wing ♂ 40-42, ♂ 42.

Male, color reddish brown. Front red, margin of mouth, antennæ and basal part of vertex fuscous. Rear of eyes narrowly yellowish on the sides, remainder brown. Hind wing with anal angle and oftentimes apex fuscous. Abdomen reddish brown, segments 8–10 with black dorsal band. Female similar to the

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[illegible]A Hagen.

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male. Easily separated from *flavescens* by the red base, and fuscous spot at anal angle of hind wing.

The species has been taken at Columbus (Osburn), Laramie Reservoir (Williamson), and Columbus, in July.

TRAMEA, Hagen.

This genus contains three Ohio species. The base of hind wing in all of them is wide and conspicuously colored. Abdominal segments 3 and 4 with one additional transverse carina, nodal sector not waved or broken.

1. Basal fourth or fifth of hind wings violet black..............*lacerata*.
   Basal part of hind wings brown..2.
2. Basal third of hind wings brown, hamule not exceeding the genital lobe in length, vulvar lamina shorter than 9........*carolina*.
   Basal fourth of hind wing brown, hamule exceeding the genital lobe, vulvar lamina as long as 9,.....................................*onusta*.

Tramea lacerata, Hagen.

Length: of abdomen ♂ 37, ♀ 35; hind wing ♂ 42–45, ♀ 46.

Male, color brownish black. Front blackish, vertex and large part of frons metallic violet. Thorax with a greenish reflection, legs black, anterior wings hyaline, black at extreme base, hind wings violet black at base, the outer edge ragged, a triangular, hyaline space near the middle of the anal margin. A large light colored spot on the dorsum of the seventh abdominal segment, often obscure in dry specimens. Superior appendages as long as one half of 8+9+10, hamule shorter than the genital lobe.

The female has yellowish white markings on 3-7; on 3-5 these consist of a pair of small spots. Vulvar lamina one half as long as 9.

The species is common in all parts of the state during a large part of the summer.

Tramea carolina, Linn.

Length: of abdomen ♂ ♀ 32; hind wing ♂ ♀ 41.

Male, color reddish brown. Superior part of frons violet. Femora brownish at base, black at apex, tibiæ and tarsi black; front wings hyaline, extreme base yellowish, hind wings reddish brown at base for nearly a third of their length, within the space many of the fine veins are yellowish. Abdominal segments 8-10 black above. Superior appendages a little longer than 9+10, slender and pointed at apex. Inferior appendage nearly two thirds as long as the Superiors. Hamules as long as, or very slightly longer than the genital lobes. Female abdominal segments 8 and 9 black, vulvar lamina not quite as long as 9, bilobed.

A comparatively common species in various parts of the state during the summer months.

Tramea onusta, Hagen.

Length: of abdomen ♂ 31, ♀ 33; hind wing ♂ 38-41 ♀ 42.

Male, color reddish brown, vertex brown, front reddish brown, in the specimens before me not showing the violet present on the superior part of the frons in *carolina*. Femora brownish at base, black at apex, tibiæ and tarsi black; wings, anterior pair hyaline, extreme base brown, the reddish brown patch at the base of the posterior pair is narrower than in *carolina* and the outer edge is more ragged. Superior appendages a little longer than 9+10, hamules noticeably longer than the genital lobes.

Female vulvar lamina as long as 9, bilobed in its apical three fourths.

Taken at Columbus May 7, and at Cincinnati (Dury) May 23.

LIBELLULA, Linn.

In *Libellula* the posterior lobe of the prothorax is small and entire. The male is without hooks on the

first abdominal segment. Nine Ohio species are considered under this genus. Several of them are very common forms, while others are local or rare. None of them fly very early in Spring.

The following key will aid in separating the species:

1. Base of wings black nearly to middle for entire width.......*basalis*.
   Base of wings transparent for at least a part of the width.........2
2. A dark colored patch of more or less extent at nodus of each wing.........3.
   No dark patch at nodus.........6.
3. Dark marking at nodus entirely posterior to it, small.........4.
   Dark marking at nodus surrounding it, much larger.........5.
4. Base of hind wing with a triangular, black patch which is produced at its outer angle, apex of wings transparent *quadrimaculata*.
   Base of hind wing with only the space between second and third veins, black, apex of wings fuscous, more prominently in the female.........*vibrans*.
5. Dark markings at base occupying nearly the anterior half of basal third of wing.........*pulchella*.
   Dark markings at base small, situated near the middle of basal part of wing.........*semifasciata*.
6. Pterostigma prominently bicolored, yellow and black......*cyanea*.
   Pterostigma not bicolored.........7.
7. Wings with dark markings at base.........*exusta*.
   Wings with no dark markings at base.........8.
8. Yellowish species, pterostigma yellowish with the veins above and below it black, costal third of wing membrane yellowish. *auripennis*.
   Dark species, pterostigma black, wings transparent except at apex in the female where they are fuscous.........*incesta*.

Libellula basalis, Say.

Length: of abdomen ♂ 29-31, ♀ 26; hind wing ♂ 41, ♀ 38.

Male, color blackish brown. Front yellowish to dark brown with a bluish tinge in fully matured specimens. Thorax with a mid-dorsal stripe yellow and a humeral and one lateral stripe dark in specimens not fully colored, in old specimens these markings are more or less obscured and the whole thorax is uniform blackish brown. Abdomen with a yellowish stripe each side which also is more or less obscured in old specimens.

Legs black, wings black on basal half to third, beyond this white, apical third clearly transparent.

The female usually lacks the white on the wings and the black at base is shorter and often reduced, especially on the fore wings, so that it has a smoky appearance. Apex of the wings often fuscous.

The species is very common and is usually the first species to attract the attention of the amateur collector. Like the other species of the genus, it prefers the vicinity of stagnant ponds where the sun's rays are unobstructed.

Libellula auripennis, Burmeister.

Length: of abdomen ♂ 36, ♀ 34; hind wing ♂ 38, ♀ 39.

Male, colors yellowish to brownish. Front in fully matured specimens shining brown, variable according to the stage of coloration of the specimen. In teneral specimens the mid-dorsal thoracic stripe is present, later this is obscured. The dorsal black stripe on the abdomen is apparently constant. Wings with a yellowish tinge, more prominent along the front margin, pterostigma yellowish, bounded by black veins.

The female is similar to the male, but has the apex of the wings smoky.

This species is quite distinct from other Ohio forms, but appears to be very close to *plumbea* of the eastern states. It may be separated from that species however by the absence of a brown, basal streak between subcostal and median veins.

Hagen reported this species from Ohio, but it has not been taken in recent years, until the past summer when specimens were procured at Cincinnati. It is probably a coast species by preference.

Libellula cyanea, Fabricius.

Length: of abdomen ♂ 30, ♀ 27; hind wing ♂ 35, ♀ 35.

Male, colors yellow and brown, wholly blue pruinose in old specimens. Front, mid-dorsal stripe and lateral spots on thorax, and abdomen each side, yellowish. In old specimens these markings are all obscured. Wings yellowish along the front margin, at base the space between subcostal and median veins black. Pterostigma bicolored, inner half sulphur yellow, outer half black.

The female has the wings decidedly black at apex, and in old specimens the yellow is encroached upon by brown.

The species so far has been taken in only one locality in the state. Here it has been observed two years in succession and no less than a dozen specimens taken, so we have no doubt that it is a permanent resident in Ohio.

Mr. J. B. Parker secured specimens at Danville in June 1897 and '98.

Libellula vibrans, Fabricius.

Length: of abdomen ♂ 40, ♀ 38; hind wing ♂ 46, ♀ 48.

Male, colors brown and yellowish, old specimens pruinose. Front olive, labrum and labium yellow, the latter black at middle, margins of mouth and mandibles black. Thorax yellow on the sides marked with black below, prothorax more or less black. Mid-dorsal stripe on thorax yellow. All these markings may become obsolete in old specimens. Abdomen yellow on the sides at first, but later no markings can be seen. Wings transparent, space between subcostal and median veins at base, a small spot at nodus, and extreme apex black.

The female has more black at apex of wings. This is the largest species of the genus in our fauna, the small nodal spots in connection with the basal space

between subcostal and median veins will characterize the species.

It is not a common form, but has been taken at Licking Reservoir and at Columbus (R. C. Osburn) in June.

Libellula incesta, Hagen.

Length: of abdomen ♂ 35–36, ♀ 32–33; hind wing ♂ 39, ♀ 40.

Male, yellowish to blue pruinose according to age. Teneral specimens have the front, sides of thorax and abdomen yellowish. Fully matured specimens have the front dark, nasus metallic superiorly, thorax and abdomen uniform blue, pruinose. No nodal patch or basal coloration, but some specimens have the nodus very narrowly margined with fuscous on each side.

The female retains more or less of the yellowish on front, thorax and abdomen throughout life. Her wings are like those of the male except they are fuscous at apex.

The clear transparent wings without nodal or basal spots will serve to separate this species from all others.

This seems to be a widely distributed species in the state, and in places is abundant. At Sandusky it is on the wing in June and July.

Libellula exusta, Say.

Length: of abdomen ♂ 25, ♀ 23; hind wing ♂ 33, ♀ 31.

Mature male, front olive, labrum and labium yellowish, occiput black, front of thorax and abdomen pruinose, sides of thorax brownish, humerus darker. Fore wings with two, short, basal streaks fuscous extreme base brownish. Hind wings at base with space between subcosta and median vein, and a triangular spot behind submedian vein fuscous, membranule

white. The thorax and abdomen of teneral specimens are lighter colored and not pruinose.

Female similar to the male.

This is the smallest species of the genus, taken in the state.

Four males taken at Stewart's Lake in Portage County, June 21, 1898. Not reported from any other section.

Libellula quadrimaculata, Linn.

Length: of abdomen ♂ 30, ♀ 30; hind wing ♂ 35, ♀ 36.

Male, colors olive, fuscous and yellow. Frons above black, in front yellowish, nasus and rhinarium olive, labrum yellow in the middle, edges black, labium yellow on the side, black between; rear of eyes black with two yellow spots. Thorax with narrow humeral and side stripes black, and two prominent spots yellow, prothorax and legs black. Front wings yellowish at base, nodal spot small, fuscous, hind wings with a basal, fuscous patch below the submedian vein; superior to this yellowish, nodal spot as in the fore wings. Abdomen yellowish or olive with black on venter and dorsum of 7–10.

The female has a conspicuous row of yellow dashes on each side of the abdomen from segment 3 to 9.

This species has been taken in the central and northern parts of the state but seems to be rare. It is on the wing in June.

Libellula semifasciata, Burmeister.

Length: of abdomen ♂ 26-28, ♀ 25-27; hind wings ♂ 35-37, ♀ 36-38.

Male, colors yellowish and fuscous; front yellowish, largely replaced by red. Rear of eyes brown with yellowish outer margin. Thorax browish yellow with two lighter colored lateral bands; femora at base

yellowish, remainder of legs and feet fuscous. Fore wings yellowish on basal third, space between bases of sectors of arculus and a space below this between submedian vein and postcosta fuscous, a patch surrounding nodus, and apex brown; hind wings like the fore wings except the fuscous below the submedian vein is wider and extends to base and usually in addition a brownish patch near middle of the anal margin. Abdomen yellowish with fuscous, dorsal band present on 6–10.

Female like the male except the extreme apex of wing is hyaline. I have seen some males also with this character apparent.

A common form in all sections of the state.

Libellula pulchella, Drury.

Length: of abdomen ♂ 33-35, ♀ 32; hind wings ♂ 40-44, ♀ 42.

Male, colors brown, yellowish and fuscous. Front brownish, two yellowish spots behind the eyes. Thorax with two yellowish, lateral bands. Wings, a patch at base, a patch surrounding nodus, and apex fuscous. The basal patch is one fourth or more of the length of the wings and gradually widened distally but at no point touches either costa or posterior margin. Dark markings of hind wings like those of fore wings. Anal margin of hind wings and patches alternating with dark markings on all the wings whitish especially in old specimens. Abdomen with a yellowish longitudinal band each side.

Female similiar to the male, but whitish on the wings may be absent. Old specimens of both sexes are pruinose.

A common form everywhere during a large part of the summer and autumn.

PLATHEMIS, Hagen.

The single Ohio species of this genus has the appearance of a *Libellula*, but the pair of hooks on the under side of the first abdominal segment of the male characterizes that sex. The female is much like *L. pulchella*. but its much smaller size will separate it from that species.

Plathemis trimaculata, De Geer.

Length: of abdomen ♂ 28, ♀ 24 ; hind wing ♂ 32, ♀ 35.

Male, colors brown and yellowish. Front brown, labrum and labium yellowish, rear of eyes brown with two bright yellow spots on each side.. Thorax each side with two oblique, white stripes each terminating below with a yellow spot. A row of oblique yellowish spots on each side of the abdomen from 2–9. Wings, at base with a brown patch which in width extends from above the subcosta to the postcosta and in length about one fourth the extent of the wing, at middle with a brown patch covering the whole width, and in length reaching from before the nodus to about the middle of the pterostigma, apex from thence hyaline.

The female has the basal patch brown as in the male, a large nodal patch not reaching the posterior margin, and the apex of the wing from the middle of the pterostigma, brown.

The species is common everywhere, and may be seen resting on logs and fences along the edges of woods, as well as flying over stagnant ponds and running streams.

CELITHEMIS, Hagen.

The members of this genus are all graceful and active species. The wings are ample and variously marked, even in the same species. As they fly along the margins of ponds and lakes they are very attractive

to the collector who at once is filled with a desire to procure specimens, but he may experience many disappointments before his prize is captured. They spend much of the time perched upon the tips of sticks and reeds near the waters edge. The female of some of the species remain in concealed places a great deal of the time and consequently are seldom taken, while with others this sex is taken as frequently as the male. The female is attended by the male a great deal of the time while ovipositing.

Our three species may be separated as follows :

1. Expanse not less than 65 m. m., wings uniform yellowish with brown markings, apex of wings beyond pterostigma with no apparent brown or fuscous markings.............................*eponina*.
   Expanse not more than 60 m.m. wings hyaline with brown, yellowish or fuscous markings, apex of wings beyond pterostigma marked with brown or fuscous..2.
2. Wings with brown and yellowish markings, pterostigma reddish *elisa*.
   Wings with fuscous or black markings, pterostigma black *fasciata*.

Celethemis eponina, Drury.

Length: of abdomen ♂ 25-27, ♀ 23-25; hind wing ♂ 31-33, ♀ 30-32.

Male; colors brown and yellowish. Front brownish, thorax with two, narrow, black, lateral bands, abdomen with dorsal and lateral bands present, yellow. Fore wings yellowish with a spot between arculus and outer side of triangle, a band at nodus not attaining the posterior margin and a band before the pterostigma usually reaching the posterior margin, brown. Hind wings yellowish with a patch attaining the base and extending to distal part of triangle, a spot near anal angle, a divided nodal band and band before pterostigma, brown. Any of these markings may be reduced.

The front of the female is usually yellow, and the ground color of the wings is lighter than in the male.

The markings of the wings are like those in the male but may be very much reduced, but not entirely absent.

An exceedingly abundant species in all sections. In the marshes around Sandusky Bay it is more common perhaps than any other dragonfly during July. Pairs in copulation were taken July 18, 1896.

Celethemis elisa, Hagen.

Length: of abdomen ♂ 20-22, ♀ 19-20; hind wing ♂ 27, ♀ 25.

Colors: male, red, black and yellowish, front red; fore wings hyaline, base yellowish a point above the triangle, a spot beyond the nodus, and apex reddish brown; most of the cross veins along the costal margin, margined with brown, pterostigma yellowish to red.

Hind wings hyaline, with an elongated, irregular patch extending from base of wing to beyond the outer part of the triangle, a large patch below this not quite reaching the posterior or anal margin, a patch beyond nodus, and apex, reddish brown; the basal foruth of the wing where not occupied by brown is yellowish, pterostigma and cross veins as in the fore wings. Abdomen black, superior parts of 3-7, except apex, red.

In the female the front is yellowish, the color at the base of the hind wings is clearer than in the other sex, and abdominal segments 2-7 are yellow superiorly; otherwise like the male.

The form is very common in northern Ohio and has been taken in the southern part of the state. Differing from the preceding species, the females are taken much less commonly than the males.

Celithemis fasciata, Kirby.

Length: of abdomen ♂ 23, ♀ 21; hind wing ♂ 27-28, ♀ 27.

Male, colors black and yellow. Front; frons metallic blue, nasus, rhinarium and labrum yellow in

some specimens, black in others; labium yellow at the sides, black at middle, in one specimen the yellow parts are olive to brown. There is so much variation in these parts, that definite statements regarding them can not be formulated. Thorax in one specimen yellowish on the sides with two black bands, in another the yellowish is entirely absent. Fore wings hyaline, fuscous or black as follows: apex from distal part of pterostigma; a patch beginning at costa, nearer the pterostigma than the nodus and extending backwards half way across the wing; this patch is narrowed or nearly divided near its middle, making it somewhat hour-glass form; and a patch beginning at nodus below the subcosta and extending towards the base of the wing; at some point between nodus and triangle this patch is divided, sending a superior branch to base between subcostal and median veins, and an inferior branch to beyond the inner side of the triangle between the sectors of the arculus; a small patch including the superior part of the triangle connects with the inferior branch and sends a spur towards the base of the wing between submedian and postcostal veins. This spur and the superior branch mentioned above may or may not be interrupted by clear spaces. In the hind wings the apex and patch before the pterostigma are as in the fore wings, except the latter may be entirely divided. Distally the basal patch may be bounded below by the lower sector of the arculus or it may send back a process which in extreme cases reaches the lower sector of the triangle; the basal patch, also includes the entire triangle and a basal process which extends backwards and terminates on a level with the distal end of the membranule; included within the basal patch is a hyaline patch which occupies the space between median and submedian veins to arculus, and the space between median vein and superior sector of the arculus to a point above the

outer part of the triangle. In addition the hind wings have a nearly round spot before the anal angle. The abdomen is uniform black in all specimens before me, but I should suppose that in teneral specimens it might be otherwise.

The female has the extreme apex of all of the wings hyaline. The extremity of the distal process of the basal patch in the hind wings is separated from the main part in one specimen and exists as a separate spot. The spot before the anal angle is reduced in all my specimens, and in one specimen is very small. The front is yellowish and the abdomen has a dorsal band in the form of triangular spots on segments 2-8; various yellow markings are present on the sides of the abdomen in a teneral specimen but are absent in a mature specimen.

The species seem to prefer small lakes where the water is clear. Six specimens were taken in Summit County along the shores of Silver and Summit Lakes in June and July. June 23 was the earliest date that specimens were taken, at this time the females were teneral, but the males had full colors. Their actions in the field are like those *C. elisa.*

LEUCO HINIA, Brittinger.

This genus contains only one Ohio species.

The pterostigma is short and broad, not more than twice as long as broad, the wings are yellowish and black at base. The species is a common one and like other members of its family is attracted to strgmant ponds.

Leucorhinia intacta, Hagen.

Length: of abdomen ♂ 23, ♀ 21; hind wing ♂ 24-26, ♀ 25.

Male, front white, labrum yellowish, labium black, brownish on the sides; rear of eyes black, feet and

legs black. Front wings black at extreme base, this color may extend outward a short distance between subcostal and median veins, and submedian and post-costal veins, thus forming two basal streaks. Hind wings black at base, here the color takes the form of a basal black streak and a basal triangle beneath. The abdomen is black with a superior yellow spot on the base of 7. In young specimens a dorsal spot is present on each of segments 2–7.

The female usually has more or less yellowish on the basal third of the wings, and the abdomen is stouter and marked with yellow on the sides as well as on the dorsum.

A common species.

DIPLAX, Charpentier.

Six Ohio species are included within this genus. Most of them are seldom seen flying over water but may be found in profusion in the adjoining marshes or lowlands. Males and females inhabit the same spot, and are each taken in nearly equal numbers. They are characterised while on the wing by their striking red bodies, which become dull brown in dry specimens. This red color is not apparent, however when the insect first emerges, and only comes gradually with increasing age. Old and worn specimens have lost the bright red and appear duller in coloration. One or more species may be found on the wing at any time between June 10, and the middle of October.

I offer the following Key which is largely taken from Calvert's work on the genus, as an aid in separating our species:

1. Basal half of hind wings yellowish..*5*
   Hind wings with extreme base, or not at all, yellowish..............*2*
2. Expanse over 60 millimeters, an additional carina on abdominal segment 4..*corrupta.*
   Expanse less than 60 millimeters, no additional carina on 4.......*3*

3. Male inferior appendage four fifths as long as the superiors; superiors with no prominent inferior tooth, but with 4–9 inferior denticles of which the distal one is the largest; female vulvar lamina entire........................ *vicina.*
Male inferior appendage about two thirds as long as the superiors; superiors with a prominent, inferior, median tooth on the basal side of which are 5–8 denticles; female vulvar lamina bifid........................ 4
4. Male genital hamule with a little more than its apical third bifid, posterior branch twice as wide as the anterior, front usually pinkish in fully developed specimens........................ *rubicundula.*
Genital hamule with apical fourth bifid, posterior branch at least four times wider than internal branch. Front usually whitish olive in fully developed specimens........................ *obtrusa.*
5. Male superior appendages with a prominent, inferior, median tooth; female vulvar lamina bifid at apex........................ *assimilata.*
Male superior appendages with no prominent inferior tooth, but with 4–9 inferior denticles of which the distal one is the largest; female vulvar lamina entire........................ *semicincta.*

Diplax rubicundula, Say.

Length: of abdomen ♂ 22-26, ♀ 22-24; hind wing ♂ 25-29, ♀ 26-28.

Male; front yellowish to reddish, wings hyaline, extreme base of both pairs yellowish, femora brownish at base and on the inner side, remainder of legs and feet black. Abdominal segments 3–10 black on the sides, and brown beneath. Genital hamules bifid for a little more than a third of their length, the anterior lobe longest, a little curved, and acute and tipped with black at apex; the posterior lobe is nearly triangular in outline with the apex rounded. Superior appendages with a prominent, inferior tooth at middle, bearing on its proximal side about seven teeth. Inferior appendage reaching nearly two thirds the length of the superiors and bearing a hook-like tooth on each side above. From below the inferior appendage is nearly conical with apex broad and slightly prominent at the sides.

The female is similar to the male in color and size. The vulvar lamina is bifid at apex.

This species is abundant from the middle of June to the first of October.

Diplax assimilata, Uhler.

Length: of abdomen ♂ 24-25, ♀ 22-25; hind wing ♂ 26-29, ♀ 26-30.

This and the above species vary considerably in size, and one would expect to find specimens both larger and smaller than the measurements given.

D. assimilata has been placed as a synonym of *rubicundula* by Calvert. but by others it is considered a distinct species. After a careful study of the anatomy of both, I am unable to give any constant character for their separation except the yellowish coloring of the basal half of the wings in *assimilata*.

Toledo July 30, Sandusky July 20, not uncommon at Columbus.

Diplax obtrusa, Hagen.

Length of abdomen ♂ 22-25, ♀ 24; hind wing ♂ 22-25, ♀ 23-25.

This species resembles *rubicundula* so much that it seems best to give simply the points of difference between the two species.

Genital hamules of the male with apical fourth bifid, the branches of the same length; posterior branch at least four times as wide as the internal branch.

The female is separated from the female of *rubicundula* by the vulvar lamina. In the last named species this is short, rather broad and bifid at the tip. The two lobes have the appearance of being inflated, are strongly convex below, and straight above and terminate rather abruptly; while in *obtrusa* the hamule, although short, and bifid at the apex, is narrower, the two lobes have an angular appearance, are only slightly convex below, and each slopes rather gradually to an acute point at apex. Instead of appearing inflated, the two lobes rather appear contracted.

In both sexes the front is more nearly white than in *rubicundula.*

The species is common in all parts of the state. It begins to fly in July and is most abundant in August and the first part of September.

Diplax vicina, Hagen.

Length: of abdomen ♂ 21-23, ♀ 20-24; hind wing ♂ 24-25, ♀ 22-25.

Colors as in *rubicundula*, yellowish in teneral specimens, red in fully matured specimens. Male, front reddish. legs and feet brown or at least not black; wings hyaline, yellowish at extreme base.

Genital hamules small, bifid for more than half their length from apex, the two branches of nearly the same width at base. the anterior one longer, curved and acutely pointed at apex; the posterior one widest near the middle and irregularly rounded at apex. Superior appendages widest half way between middle and apex, before the widest point are about five inferior teeth. Inferior appendage nearly four fifths as long as the superiors.

Female, vulvar lamina widest behind, distinctly projecting, hind margin entire.

Taken in all sections of the state, and appears later in autumn than any other species of the genus. Taken in copulation Nov. 7, at Columbus.

Diplax semicincta, Say.

Length: of abdomen ♂ 18-21, ♀ 17-21; hind wing ♂ 21-25, ♂ 20-24.5.

Colors, yellowish in teneral specimens, red in fully matured specimens. Male, front reddish to yellowish. Legs at base and inferior side of front femora reddish, remaining parts blackish. Basal part of front wings, sometimes to triangle, sometimes to nodus yellowish; hind wings, basal half yellowish.

Genital hamules bifid for apical half, the anterior branch shorter pointed and slightly hooked at apex, posterior lobe three times as broad as the anterior, apex rounded. Superior appendages with about six inferior teeth beyond the middle. Inferior appendage four fifths as long as the superiors.

Female colored like the male or with yellowish part of fore wings brighter than in that sex. Vulvar lamina short, only slightly projecting, posterior margin entire.

Taken at Columbus. Common at Sandusky in July.

Diplax corrupta, Hagen.

Length: of abdomen ♂ 26-29, ♀ 27-28; hind wing ♂ 28-30, ♀ 29-31.

Male, teneral, yellowish; front yellowish, thorax with an antehumeral, a narrow humeral, and two lateral bands terminated below by a bright yellow spot, graysih. Abdomen yellowish, sides with the ventral margins of the segments black; dorsal spots on 8 and 9. Legs, at base, and superior side of femora and tibiæ yellow, other parts black. Wings nyaline with veins and pterostigma yellowish.

The male when fully colored is red. The markings on the thorax are reduced to the two bright yellow points or spots on each side. The legs are like those of the teneral form. The venation of the wings is reddish. Genital hamules small, apical third bifid, anterior branch short, sickle form and acute at apex; posterior branch twice as long, several times as broad, directed obliquely outwards and backwards, rounded at apex. Superior appendages 2 m.m. in length, yellow, with a row of inferior, black denticles which begin near basal third and extend to where the appendage begins to narrow; apex tipped with an acute, black spine. Inferior appendage three fourths as long as the superiors.

Female colored like the male, except her front is lighter, usually yellowish. Vulvar lamina short, most prominent at the sides.

The large size of this species separates it from other Ohio members of the genus.

One should observe *corrupta* in the field for one season to become thoroughly acquainted with its variations. If he does not know it in all its stages to begin with, and if he is eager to obtain the greatest number of forms possible in a certain locality, he can easily convince himself that the various colorations it presents, represents at least three distinct species.

It is common in all parts of the state during July and August.

PERITHEMIS, Hagen.

In the single species of this genus, the hind wings are longer than the abdomen. Although very common around water, it is not conspicuous because of small size and rather secluded habits. It flies low and rests a part of the time on water plants or anything that projects above the water. While its colors are developing after emergence it may be found in the fields some distance from water. Males and females are taken usually in about equal members.

Perithemis domitia, Drury.

Length: of abdomen ♂ 14-15, ♀ 13-14; hind wing ♀ 19-20, ♀ 19-20.

Male, colors yellowish to brown, wings uniform yellowish or sometimes with a brownish point above the triangle. Thorax often with two olive, lateral bands or with each band represented by a small spot below the middle; these thoracic markings may be obscure or wanting. Abdomen nearly uniform brown in dry specimens.

Female, front wings with costal margin yellowish nearly to pterostigma, a patch at nodus extends

backwards almost to posterior margin, and a much smaller patch above the outer part of the triangle, brown; hind wings with costa and nodal patch as in the fore wings, but the other patch includes the triangle and is extended backwards nearly to the anal angle, and sends two branches to base, one between the subcostal and median veins and another between submedian and postcostal veins. These markings are snbject to variation in extent and intensity of color.

Common in all parts of the state from June to September.

MESOTHEMIS, Hagen.

The single Ohio species of this genus is very common. The males are most often seen as they fly over open water a part of the time, the female usually remain among grass and weeds that grow either in or near the water; she is very attractive, but her green color protects her somewhat, and she may fly very near the collectors feet without being observed. She oviposits among low plants that grow in the water.

Mesothemis simplicicollis, Say.

Length: of abdomen ♂ 27-32, ♀ 29-31; hind wing ♂ 30-33, ♀ 32-34.

Male, colors black and green. Rear of eyes yellow marked with brown in such a manner that they appear chequered. Thorax green, legs black. Both thorax and abdomen blue pruinose in old males. Superior appendages yellow, a row of black denticles extending nearly the whole length of inferior edge. Inferior appendage brown, four fifths as long as the superiors.

In the female the abdomen is green with distal part of 4-7 and all of 8 and 9 dark brown above. All the segments more or less dark brown below. Vulvar lamina triangular, margin entire.

Abundant throughout the state, from May to September.

PACHYDIPLAX, Brauer.

This genus is represented by a single species.

The frons above and vertex are metallic blue, which character will separate it from related forms. It flies over shallow water where lilies and other water plants grow, here the female oviposits. Teneral specimens may be found a long distance from water.

Pachydiplax longipennis, Burm.

Length: of abdomen ♂ 20.29, ♀ 18-24; hind wing ♂ 25-33, ♀ 25-31.

Teneral male, front, labrum and labium yellowish, margins of mouth brown, frons above and vertex metallic blue. Thorax with mid-dorsal carina, an antehumeral stripe, abbreviated above, an irregular humeral stripe continued above by a transverse stripe before the antealar sinus, a wide, lateral stripe beneath the fore wings, one between the wings and all the posterior part of metathorax, yellow; otherwise brown. Legs; coxæ, trochanters and inner side of front tibiæ, yellowish; remainder including the feet dark brown. Wings yellowish at base, otherwise hyaline. Abdomen, venter and basal part at sides yellowish, dorsum brownish or blackish usually with a longitudinal row of yellow dashes on 2-8.

In the fully developed male the abdomen becomes pruinose and all the markings are obscured, the brown of the thorax becomes more or less greenish, and the hind wings have two longitudinal, dark brown, basal streaks, one between subcosta and median veins, the other between submedian and postcostal veins; both reach nearly to arculus. These latter may be present in teneral males.

The female is colored like the teneral male or pruinose in old specimens, her abdomen is widened posteriorly, her wings are yellowish at extreme base and the hind pair lack the longitudinal stripes.

Common in all parts of the state.

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NOTE.—Mr. E. B. Williamson concludes that *Enellagma Fischeri* is equivelent to Say's *antennata*. A conclusion which he states is concurred in by Mr. P. P. Calvert.

EIGHTH ANNUAL REPORT

OF THE

OHIO STATE

ACADEMY OF SCIENCE.

PUBLISHED BY THE ACADEMY.

1900.

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1900.

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Deceased.

Edward Orton, - Columbus

EIGHTH ANNUAL REPORT

OF THE

OHIO STATE ACADEMY OF SCIENCE.

WINTER MEETING.

The ninth annual meeting was held at the Public Library Building in Cleveland, December 22nd and 23rd, 1899. The attendance surpassed that of any previous winter meeting. With only two exceptions the forty-eight papers on the printed program were presented, nearly all of them by their authors. Although no time was wasted, it was found necessary, in order to complete the program before 5 o'clock Saturday afternoon, to separate into sections. Accordingly at 2:15 the botanists withdrew to a separate room to hear the botanical papers which remained unread at that time.

A. D. Selby and J. A. Bownocker were appointed a committee to draft resolutions regarding the two members who had died during the year,—Doctor Orton and General Force.

After some discussion, the Academy voted to have a committee appointed to prepare a directory of the streams, lakes, ponds, artificial reservoirs, swamps and marshes of Ohio. The president appointed the following on this committee:—E. B. Williamson, W. A. Kellerman, Gerard Fowke.

A committee consisting of H. C. Beardslee and Herbert Osborn was elected for the purpose of deciding on the best system of colors to be adopted for general use in scientific descriptions.

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Smith, Prof. J
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The carefully prepared report of the committee on science teaching formed an important part of the program and elicited much useful discussion.

The publication committee reported that the Special Papers, No. 1. and 2., and the Seventh Annual Report, in all 353 pages, had been published during the year at a cost to the Academy of $197.10.

REPORT OF THE TRUSTEES.

The following grants were made from the McMillin Research Fund:

W. G. Tight, to aid in the study of the preglacial drainage of the Muskingum valley,	$50.00
J. A. Bownocker, to aid in the study of preglacial drainage in the Miami valley and the upper Maumee valley,	50.00
J. H. Todd, to aid in study of preglacial drainage of Wayne and adjacent counties,	10.00
Herbert Osborn, to aid in the study of the fishes of northern and southern Ohio,	50.00
Total,	$160.00

The trustees have decided to use the balance of $90.00 in illustrating Special Papers, No. 3, to contain all reports of the work on preglacial drainage in Ohio done by members of the Academy, and Mr. McMillin has sanctioned the use in this manner.

The following communication has recently been received from Mr. McMillin:

NEW YORK, DEC. 14, 1899.

F. M. Webster, M. Sc., Wooster, Ohio.

DEAR SIR:—I am in receipt of your letter of 12th, enclosing to me bills of expenses incurred in research work, and paid from funds I contributed to the Association, for which I thank you. I am sending to-day to the Capital City Bank a check for $250.00, to be placed to the credit of your committee for the use of the society during the coming year. Yours truly, EMERSON MCMILLIN.

F. M. WEBSTER, Chairman.

At the Saturday morning session a committee consisting of A. D. Selby, C. E. Slocum and J. A. Bownocker was elected to draft resolutions to be presented at the afternoon session concerning a topographic survey of the state. Following are the resolutions:

RESOLUTIONS REGARDING TOPOGRAPHIC SURVEY.

The Ohio State Academy of Science earnestly seeks to secure a topographic survey of Ohio. Such a survey is demanded that accurate maps may replace the present inaccurate ones. This will require complete triangulation of the state anew by competent engineers and result in detailed maps of every township of the state, showing the elevation of the land and all drainage systems. Such maps, when accurately made will be of inestimable value to all the citizens of the state, to trustees of water works, city officials, county and township officers, individual land owners, and to scientists they will furnish the only adequate basis for their endeavors now and for the large plans of the future.

Ohio cannot afford to lag behind other states in this great work, which may now be completed in conjunction with the United States Geological Survey, thus securing at once economy, accuracy and uniformity.

Resolved, That to strengthen the hands of the committee on Topographic Survey appointed by the Academy three years since, and secure proper legislation in Ohio, the president be authorized to appoint two additional members of the committee; said members to be residents of Columbus or easily accessible to that city.

The amendment to Article IV of the constitution, duly proposed the year before, was adopted.

AMENDMENT TO ARTICLE IV OF THE CONSTITUTION.

There shall be a Board of Trustees consisting of three members; one elected for one year, one for two years, one for three years, and thereafter one elected annually for three years.

It shall be the duty of this Board of Trustees to act as the custodian of all property of the Academy and to administer all funds received for original research and investigation.

The following resolution offered by Professor Osborn was adopted:

Moved that the trustees be instructed to appoint a librarian who shall have charge of the distribution of publications and who shall arrange an exchange with other societies and receive and list all exchanges. Exchanges so received shall be accessible to all members for consultation or may upon payment of transportation charges be withdrawn for reasonable periods of time.

Twenty-six new members were elected.

Saturday evening quite a number of the members went to the Physical Laboratory of Case School where they were pleasantly entertained by Professor Miller

and his assistant with an exhibition of wireless telegraphy, Rœntgen rays, illuminated Geissler tubes and many other delicate pieces of apparatus.

PAPERS READ.

1. Notes on a few Northern Ohio Fungi, - H. C. BEARDSLEE
2. Notes on Ohio Salix, - - - - - - - - A. D. SELBY
3. Ohio Species of Crepidotus, - - - H. C. BEARDSLEE
4. New Fish Bones frem the Cleveland Shale, - WM. CLARK
5. Some Insect Notes, - - - - - - - F. M. WEBSTER
6. Mollusca of Tuscarawas County, - - - - V. STERKI
7. Distribution of the Hydrophytic Siphonogams of Ohio, W. A. KELLERMAN
8. List of Some of the Higher Phagophytes of Ohio. JOHN H. SCHAFFNER
9. A Scheme for a Catalogue of the Streams, Lakes and Swamps of Ohio, - - - - - E. B. WILLIAMSON
10. Preglacial Drainage of Wayne and Associate Counties, J. H. TODD
11. A Deep Preglacial Channel in Western Ohio and Eastern Indiana, - - - - - - - - J. A. BOWNOCKER
12. Report of Drainage Modifications on the Lower Muskingum and Ohio Rivers, - - - - - W. G. TIGHT
13. Notes on the Drainage of the Little Miami River, J. A. BOWNOCKER
14. Notes on the Occurrence and Distribution of some Ohio Fishes, RAYMOND OSBURN
15. The Non-indigenous Flora of Ohio, W. A. and MRS. KELLERMAN
16. On the use of some Important Botanical Terms, JOHN H. SCHAFFNER
17. The Moulting of Birds, - - - - - - LYNDS JONES
18. Additional Records for Ohio Hemiptera, - - H. OSBORN
19. Occasional Abundance of Certain Birds on or near Lake Erie, - - - - - - - - - E. L. MOSELEY
20. Species of Filamentous Algae of Cuyahoga County, J. R. WATSON
21. Five Plants not reported for Erie County in the Sandusky Flora, - - - W. A. KELLERMAN and R. F. GRIGGS
22. Record of Additions to the Ohio List of Plants for 1899, W. A. KELLERMAN
23. Future Work of the Academy of Science in Ohio, F. M. WEBSTER
24. Plant Photographs, - - - - - - CARL KREBS
25. Out-door Work in Geography, - - HERBERT C. WOOD

26. Working Methods with the Fleshy Fungi, H. C. Beardslee
27. Additions to the Ohio Flora, - - - - A. D. Selby
28. Report of the Committee on Science Teaching in the Public Schools, - - - W. A. Kellerman, Mary E. Law, Wm. Werthner, J. A. Bownocker, C. J. Herrick.
29. Do Bob-Whites Migrate?- - - - - E. E. Masterman
30. Notes on the Internal Temperature of Trees, W. R. Lazenby
31. Diphtheria and Antitoxin, - - - - R. G. Schnee
32. Defiance Glacial Bay, - - - - - Chas. E. Slocum
33. The Ecological Plant Geography of Ohio, - A. D. Selby
34. The Maximum Height of Some Common Plants, John H. Schaffner
35. The Pollinization of Corn, - - - - W. R. Lazenby
36. Notes on Termes, - - - - - - F. L. Odenbach
37. Notes on the Insect Fauna of Sandusky, - - H. Osborn
38, Experiments with the Sorghum Smuts, W. A. Kellerman
39. Shark's Teeth found in Wayne County, - - J. H. Todd
40. The Tumbleweeds of Ohio, - - - J. H. Schaffner
41. Flora of the Muskingum valley and Survey Work, A. D. Selby
42. Displacement of the Black Variety of Sciurus Carolinensis by the Gray Variety, - - - - F. M. Comstock
43. An extinct proboscidian engraved on stone by a contemporary artist, - - - - - E. L. Moseley
44. The Ohio Uredineae, W. A. Kellerman and Clara Armstrong
45. An Ecologioal Study of Big Spring Prairie, W. A. Kellrrman and Thos. Bonser
46. Railroad Weeds, - - - - - - - - L. D. Stair
47. The Ohio Willows, - W. A. Kellerman and R. F. Griggs
48. Report on the State Herbarium, - - W. A. Kellerman

President's Address—The Limitations of Scientific Discovery, G. Frederick Wright

Illustrated Lecture—The Preglacial Drainage of Ohio, W. G. Tight

SUMMER MEETING.

The summer meeting of the Academy was held in connection with the meeting at Columbus of the American Association for the Advancement of Science.

The only session was in Orton Hall, Friday, August 25th at 9 A. M. Twenty-three new members were elected. Remarks were made favoring Cleveland as the place of winter meeting. Rev. Herzer addressed the Academy on the so-called fossil genus, Sigillaria.

OCCASIONAL ABUNDANCE OF CERTAIN BIRDS ON OR NEAR LAKE ERIE.

BY E. L. MOSELEY, SANDUSKY, OHIO.

On the Saturday before last Thanksgiving citizens of Sandusky whose places of business overlook the Bay saw wild swans in such numbers as most of them had never seen before. From the shore near the western limit of the city more than a thousand could be seen at one time resting on the water. The night watchman at the Short Hine dock said they arrived during the night, though another observer saw fifty-six flying in one string the day before.

This fall was marked by the absence of cold rains and high winds. From the 14th of November the weather had been warmer every day than usual at that time of year,—on the 14th only three degrees warmer but from the 15th to the 24th on an average nine degrees warmer than the normal. This caused the swans to remain rather late in Canada. From Nov. 22nd to Nov. 25th the wind blew from the north and north-east and so they moved down to the most southerly feeding ground to be found before starting

on their long journey to the south. One that was shot proved to be a whistling swan, Olor columbianus. Most of them remained but a single day, though some were around as late as Dec. 11.

Mr. August Fettel says that every March many swans on their way north pass to the east of Sandusky, and that in the spring of 1887 when he was working on the pavillion at Cedar Point, he saw "one continuous string of swans flying only thirty or forty feet above the water for two hours. There must have been thousands of them."

Mr. Dildyne, keeper of the club-house at the West Huron marsh, says he has not seen so many swans before in the fall for ten years but that there were more last spring and he usually sees more in spring than in the fall. Mr. Ritter keeper of the range-light at the entrance to Sandusky Bay, also saw more last spring.

Canada geese appeared in great numbers this fall the same day as the swans. There may have been two thousand of them and as many swans on Sandusky Bay, Nov. 25th. Many of the geese were still there Dec. 18; and some may remain all winter, as they did two years ago.

Before sunrise, April 11th 1896, occurred a thunder-shower at Sandusky with a warm wind from the south-east. I had seen no yellow-bellied sapsuckers earlier in the season but that morning they were numerous. Seventy-five, it is said, were seen in a single yard at one time and there must have been thousands in the city. In the country, where I spent most of the day, I saw no sapsuckers. My earliest record for these birds in 1894, is April 7th; in 1898, April 7; in 1895, April 8th; in 1891 and 1899, April 10th. In 1896 they came with the warm wind of April 11th, and stopped in Sandusky for liquid refreshments before attempting to cross the lake. These sapsuckers apparently take no solid food while they are with us.

April 1st 1892, Captain Haas was detained on Rattlesnake Island by a dense fog. Wherever he

walked he could take but a few steps without starting up a wood cock. About a week later he was on the island again but could not find any of them. The same fog that made it unsafe for him to leave the island had detained the birds also.

The preceding cases are clearly traceable to the influence of the weather. Others depend rather upon local abundance of food.

October 29th, 1895, John R. Schacht, whose father is engaged in the fish business in Erie, Pa., wrote me as follows:—"To-day a boat came in with some hundred pin tail ducks which were caught in the gill nets and drowned. The nets are only five feet deep and rest on the bottom in nineteen fathoms of water. It seems the ducks dive down after the fish and thus get caught in the nets and drowned.

"The fishermen claim that they have caught as high as two hundred ducks in their nets which were in only fourteen fathoms of water. About this week and next is the time when such great numbers get caught and drowned.

"Thought I would mention the above as it seemed very remarkable that these birds dove to such great depths.

"The ducks are all of this one species,—pintail."

In his next letter he wrote:—"Since writing you about the pintails being caught in the deep water fish nets, I have inquired and found out that in the fall of 1893 one tug in one day brought in between 1000 and 1500 ducks. Also have found that they have caught them in thirty fathoms of water."

In my paper on "The White-headed Eagle in Northern Ohio," I mentioned the fact that about seventy-five eagles had been seen at one time feeding on the fish which had been caught under the ice in seines and rejected by the fishermen.

Eave swallows, after the young are full-fledged, may sometimes be seen resting in great numbers on the

wires along country roads in the vicinity of the lake marshes. In July 1894 I saw about six hundred together on the wires a few miles west of Sandusky and in 1896 about twelve hundred a few miles east of the city. Mr. Marion W. Bacome recently told me of seeing one time between Bellevue and Fremont a much greater number of "common" swallows than this. There were "at least three birds to the foot for a distance of nearly four hundred feet" and he thinks nine wires, making not less than ten thousand swallows.

PRELIMINARY LIST OF FILAMENTOUS ALGÆ OF CUYAHOGA COUNTY.

BY J. R. WATSON, ADELBERT COLLEGE, CLEVELAND, OHIO.

Cyanophyceæ.
- Oscillaria,
  - tenuis, Ag.
  - princeps, Vauch.
  - froelica fusea, Kirch.
  - anguina, Bory.*
  - limosa, Ag.*
  - lutetiana, Pet.*
  - majuscula, Kg.*
  - maxima (Hass) Witts.*
  - quinina, (Ag) Kg.
  - rivularis, Rab.
  - setiformis, (Roth) Kg.*
- Nostoc, (a doubtful genus).
  - commune, Vauch.
  - tenuissimum, Ag.*

Conjugatae.
- Oedogonium,
  - capillare (L) Kg.
  - capilliforme, Kg.*
  - cardiacum, (Hass) Hitt.*
  - paludosum, Wittr.*
- Zygnema stellium, Ag.
- Spirogyra,
  - adnata, Kg.
  - bellis, (Hass) Cleve.*
  - crassa, Kg.
  - decima, (Muhl) Kg.
  - dubia longi-articulata, Kg.*
  - elongata, (Berk) Kg.*
  - fluviatalis, Hilse
  - inflata, (Vauch) Rab.
  - jurgensii, Kg.*
  - longata (Vauch) Kg.

Chloraphyceæ.
- Draparnaldia,
  - glomerata, Ag.
  - glomerata, maxima, Wood.*
- Cladophora,
  - fracta, Kg.
  - glomerata, Kg.
  - glometata clavata, Wolle.*
  - glometata rivularis, Rab.*
  - glometata pumila, Bail.*
  - crispata vitrea, Kg.*
- Ulotrix zonata (W & M) Aresch.
  - flaccida, Kg.
- Conferva vulgaris, Rabb.
  - farlowii, Wolle.
  - floccosa, Ag.*
- Vaucheria,
  - geminata (Vauch) D. C.
  - geminata racemosa, Walz.
  - sessilis, (Vauch) D. C.
  - terrestris, Lyn.

*Not previously reported for Ohio.

FUTURE WORK OF THE ACADEMY OF SCIENCE IN OHIO.

BY F. M. WEBSTER, WOOSTER, OHIO.

Let me preface my paper with the suggestion that all science is alike to us, as a body. Science is facts classified and the mere statement of facts may, or may not, be science. The man or woman, who presents a lengthy, wordy paper, abounding in technical and obscure terms, is not likely to be a scientific person, unless such have, in their researches, gone beyond their fellows and pushed far out into the unknown. Even here, it might be well to call attention to the fact that the foremost among scientific people are noted for simplicity and brevity rather than otherwise.

As I have indicated, there is not a branch of science in which we, as members of this body, may not legitimately enter. I am indeed, pleased to note the broadening out as indicated by the program of the present meeting and hope this will continue. As to methods of investigation, it would be the height of presumption on my part to attempt to lay down any particular scheme. But when a paper comes to the publication committee, a certain amount of discretion is demanded, and with your board of trustees, it is imperative that the best possible use should be made of our funds.

We expend both time and money in attending the academy meetings, and we hope and expect to derive a certain benefit from the association with one another. But beyond this it seems to me we have a right to expect to hear new facts stated, or the new application of old ones. So also in our publications, we expect not to read of old and threadbare subjects that have been repeated again and again, but we look for additions to

the sum total of our knowledge. Therefore, as Chairman of the Board of Trustees and of the Publication Committee, I am opposed to publishing anything that does not show on it the marks of originality either in investigation or application. It is entirely possible to make a paper original, valuable, scientific and popular, all at the same time. But it is not possible to make a long, wordy compilation, that when sifted contains not a single new fact, either useful or valuable for our publications, because the periodical literature of the day is full and overflowing with matter of that sort, and it can be purchased far more cheaply there than we can afford to publish it in our Reports and Special Papers. Reports of the occurrence of new or rare forms are always in order, but even here some information in regard to habit, abundance, or peculiarities, if any are to be observed, will double their value. We want papers dealing with natural, social, political, mechanical and every other science, but we desire these to be as original as possible, and without more compilation than is necessary to explain, or indicate, the value of the original portions. I cannot conceive of a good compiler not being a good investigator for no other condition is possible. A good compiler is much like a mill that receives the grain as it comes from nature, and puts it out as a nutritious article of food. A poor compiler is like a sponge that draws in the water and forces it out again, precisely as it came in, only a bit dirtier. Our publications are not supported for the purpose of helping any one to get their names in print, but to tell to the world that we are doing something and to show that this something is of value to the scientific man or woman, wherever such may be.

This is not a criticism and should not be taken in that spirit, but it is a plea for originality in our studies and investigations, and a severe boiling down when we come to publish results. Over publication and under investigation is as fatal to an institution as it is to an individual.

EXPERIMENTS WITH THE SORGHUM SMUTS.

BY W. A. KELLERMAN, OHIO STATE UNIVERSITY.

Some experiments in smut infection with the two sorghum smuts, Ustilago reiliana and Ustilago sorghi, have been for some time carried on both in the green house and in the field. In addition to the seed infection experiments, tests were also made in the field during the past season as to the efficiency of hot water as a fungicide for the latter species.

The illustrations herewith presented show sorghum plants infected with Ustilago reiliana. No. 1 was infected and planted two years ago. No. 2 was infected and planted one year ago. Both pots of plants have been growing continuously in the green-house, and the stalks not wholly blighted by the smut have from time to time produced perfect seed. Similar infection experiments were previously carried on and have been reported elsewhere in print. My experiments in the field were not so successful as the green-house experiments. I used maize of several varieties as well as sorghum, but succeeded in obtaining only two cases of infection. These were both of popcorn. The previous year showed as little success—though in each case I used a qaantity of the smut which was apparently sound. Some of it was several years old, yet spores grown the previous season were also used. But it has been abundantly and conclusively shown that infection of sorghum plants take place in this manner—a fact of importance in connection with the application of fungicides. This smut had been reported for Kansas, New Jersey and Ohio. In Kansas it occurs on maize as well as on sorghum. The same is the case in southern Europe.

It is also known, from experiments I have previously carried on, that Ustilago sorghi also infects the

plant through the seed—i. e. penetrating the very young seedling. I have this past season repeated the experiment in the field—in every case succeeding in getting an abundaat crop of the smut.

I have also to record for the first time the experimental infection of the broomcorn plant with Ustilago sorghi. The experiment was carried on in the field. Clean seed was obtained and with this a quantity of smut spores of Ustilago sorghi from common saccharine sorghum was mixed. The majority of the stalks in the row—hundreds in number—bore smutted heads showing the efficiency of the seed infection. In the same plot tests were made with hot water as a fungicide for the grain sorghum smut (Ustilago sorghi). The seed known to have adhering smut grains was treated in the same manner as is usual for oats and wheat to prevent Ustilago avenæ and Tilletia tritici. That is, the seed was immersed for fifteen minutes in water heated to 133 degrees F. The following table shows the result:

Sorghum, seed not treated; Number of stalks [illegible], per cent smutted 19.62

Sorghum seed treated with hot water; Number of stalks [illegible]; per cent smutted [illegible]

Broomcorn seed not treated; Number of stalks [illegible]; per cent smutted [illegible]

Broomcorn seed treated with hot water; Number of stalks [illegible]; per cent smutted [illegible]

[illegible]

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Sorghum, seed not treated; Number of stalks 205, per cent. smutted 19.02.

Sorghum, seed treated with hot water; Number of stalks 179; per cent. smutted 1.12.

Broomcorn, seed not treated; Number of stalks 310; per cent. smutted 59.03.

Broomcorn, seed treated with hot water; Number of stalks 293; per cent. smutted 3.10.

Although this treatment did not wholly eradicate the smut, it is evident that in a practical sense it would be considered an efficient fungicide. As a matter of fact, an enormous amount of smut was used to infect the seed artificially before applying the hot water, and the smut wafted by breezes in the laboratory where the work was carried on would satisfactorily account for subsequent infection and the consequent small amount of smut in plants grown from the treated seed.

SOME PLANTS NEW OR LITTLE KNOWN IN OHIO.

BY A. D. SELBY, WOOSTER, OHIO.

These not reported before, include:—

Cyperus Engelmanii Steud.
Specimens from Wayne County so named. New. Collected by Mr. Duvel, Brown's Lake, 9-7-'99.

Gyrostachys præcox (Walt.) Kuntze. Duvel. Browns Lake, Sept. 7.

Rumex Patientia L.
Wooster. Duvel. New.

Chenopodium murale, (L.)
Wooster, Selby. Not new.

Scleranthus annuus L.
With crimson clover. Clyde, H. L. Persing. New.

Reseda lutea, L.
Clyde. As Scleranthus. Previously reported only from Sandusky?

Brassica juncea (L.) Cosson. Penna. Ry., Orrville, Duvel. New. Now growing more specimens.

Sida hermaphrodita L.
Northern Williams County, 1899. A. D. Selby.

Clinopodium Nepeta L.
Waterville, Lucas County, Selby.

Nabalus trifoliatus.
Wooster, '98, Duvel.

Eupatorium hyssopifolium?

Lactuca saligna L.
Dayton 1899. Abundant, Selby.

Sonchus palustris, L.
In damp vineyard near Unionville, Ashtabula County, Selby. Appears to be nearer this than *S. arvensis* L.

NOTES ON OHIO SALIX.

BY A. D. SELBY.

The working up of the Floras of the Sub station and Station Farms, including the Flora of Wayne County in which the Experiment Station is situated, has brought us in contact with a rich development of willow species. The collections have been made by the writer, aided by Mr. J. W. T. Duvel, formerly Assistant Botanist. The writer has further gathered specimens of Salix from several other localities in the state.

In Wayne County we find a diversity of willow forms including those of bogs and stream banks. Upon the Sub station at Strongsville, Cuyahoga County, the willows are not abundant. At Neapolis, Fulton County, on the other hand the willows are numerous. This farm is situated on the old lake or shore (beach) sands of that "Oak-openings" region, thé soils are very sandy. These notes, incomplete as they of course are, may be of some value to those who work upon Salix. The material has been for the most part examined and determined by Carleton R. Ball formerly of Ames, Iowa, but now of the Dwision of Agrostology, U. S. Department of Agriculture. I would express my obligations to him.

The following are some of the species collected, with localities:

Salix nigra Marsh.
Common, Wooster, Strongsville; Chillicothe; Akron; Georgesville, Franklin County.

Salix nigra falcata (Marsh) Torr., Wooster.

Salix amygdaloides Anders.
Catawba Is., Ottawa County; Georgesville, Franklin County; Akron.

Salix amygdaloides latifolia, (Anders) Bebb.
Neapolis.

Salix amygdaloides x *nigra*, "C. R. Ball."
Two specimens are so classed. One nearer *S. nigra* and the other strictly intermediate. The larger reaches a height of twenty feet.

Salix lucida Muhl.
Wooster; Akron; Doylestown; Myer's Lake and Congress Lake, Stark County.

Salix fragilis L. Wooster.

Salix alba L. Varieties.
Also possible hybrid forms, Wooster.

Salix Baylonica L.
Creek bank near Wooster, (Shreve).

Salix purpurea L.
Brownhelm, Lorain County.

Salix fluviatilis Nutt.
Wooster; Catawba Island; Georgesville; Chillicothe; Neapolis.

Salix Bebbiana Sarg.
Akron; Neapolis. Also a long leaved form, Neapolis.

Salix humilis Marsh.
Georgesville; Neapolis; Turkey Foot Lake, Summit County., Georgesville material, scarcely typical.

Salix tristis Aiton.
Georgesville; Marshfield, Athens County. Scarcely typical.

Salix discolor Muhl.
Wooster (Overton); Catawba Island; Akron; Killbuck Valley, Wayne County; Georgesville; Neapolis. Also Neapolis, toothed-leaved form.

Salix sericea Marsh.
Wooster; Akron.

Salix petiolaris J. E. Smith.
Neapolis.

Salix candida Fluegge.
Hartville Swamp, Stark County.

Salix cordata Muhl.

Wooster; Catawba Island; Neapolis and many other points.

Salix cordata angustata, (Muhl.) Bebb.

Wooster.

Salix cordata × ?

Many doubtful hybrids?

Salix cordata × *sericea?*

"Nearly the *S. cordata* × *sericea* of Dr. Glatfelter, but I cannot agree." "C. R. B."

Salix myrtilloides, L.

By Brown's Lake near Shreve, Wayne County.

The hybrid or intermediate form of *S. amygdaloides* × *nigra*, is offered as an addition should it prove worthy. I am desirous of collecting at the Station herbarium, a full representation of Ohio species of Salix. It is especially desired to gather there a very full collection of the willows of the Muskingum Valley drainage area. Contributions particularly of complete specimens, will be welcomed and cared for.

OUT-DOOR WORK IN GEOGRAPHY.

BY HERBERT C. WOOD.

The wide spread popular interest in geography in this last decade of the nineteenth century is to be compared only with that of the period of the Roman Empire, and with that of the period immediately following the discovery of America: when the Roman conqueror led in triumph through the streets of the Eternal City the strange peoples of the East, laden with gold and the other products of their far off native lands; and when Columbus revealed to Spain and all Europe the wealth and fertility of the Western Continent.

The geography of the not far distant past has been almost wholly descriptive. It has consisted of mechanical definitions of land forms and bodies of water which gave but little idea of the forms defined and none of their origin.

Countries and states were bounded, their capitals and principal towns named and located, and their products enumerated. A volcano was a "burning mountain;" and rivers rose in lakes and "emptied" into the sea. We did not learn why the volcano ejects lava and broken fragments of rock, which are wrongly called "ashes," or that it does not really "burn;" nor why the Deleware, Susquehanna, and the Potomac rivers cross the Allegheny ridges and the Blue Ridge to reach the Atlantic, while New River crosses both the Alleghany and the Blue Ridge in the opposite direction to reach the Ohio.

We learned that Albany, Trenton, Richmond, Raleigh, Columbia, and Atlanta were state capitals; but their relations to tide-water, coastal plain, and interior basin were left for more recent times to discover. In this way one continent after another was studied, and the artificial stereotyped classification applied to all. Fortunately for the pupils of the present day, the old method is a thing of the past, and a rational method has come to take its place. To two fundamental ideas is due the welcome change. *The law of cause and effect* has now come to be recognized as the guiding principle in geography as the other sciences, and under the name of "the causal notion in geography" has come to dominate our modern teaching.

The second notion is that of "*the type form,*" by which the features of the earth's surface are described with relation to the forces which operated to produce them and to give to each the characteristic structure and form which the great physiographic processes everywhere bring forth.

Now that these ideas have come to us, teachers are seeking on every hand for means to advance and develope them. I believe that the new era has only just begun; and that we are entering upon a period of wonderful progress in this science. Certainly more attention is being given to it; and its claims for more time in the curriculum and for special preparation on the part of teachers is being recognized. Full recognition cannot come too soon.

Field work in geography is but one step in the development of the causal notion. We are looking for the *forces* which have produced and are producing the type forms. To understand how these forces produce the type forms we must *see them at work*. We cannot see this in a book. We must go out-of-doors.

As soon as the necessity for such work is recognized, teachers begin to ask, "How shall we go about it?" "Where shall we go?" "What things shall we study?" and "What shall we do with what we have learned, after we return to the class-room?"

I shall not attempt to enumerate all the things that may be studied; but will describe a few experiences with my own classes in the field, and tell what we did with the material which we obtained.

We went to the gorge of Euclid Creek, ten miles east of the Public Square in Cleveland, to study the gorge and the flood-plain of that stream. It may be asked why it was necessary to go so far away to get information, when we have a river flowing through the city, with a larger volume of water, a wider valley, and a more extensive flood-plain. The reasons are two. First, the river at Cleveland lies in a densely settled district covered with many buildings and difficult of access by a large class. Second, the very fact of size and complications due to modifications and improvements made it more desirable to go out into the country, where we could find a small stream with all its features nearly in their original condition, but little modified by human agencies.

At Euclid Avenue, the stream emerges from a gorge about one hundred feet deep, and flows northward, meandering across the former bed of Lake Erie to the present shore line.

We turned our attention on this excursion to the part of the stream south of the avenue, where it has dissected the plateau which was formerly the plain bordering the lake.

We followed the stream and were soon within the gorge, and stood upon the surface of a flood-plain a quarter of a mile wide, into which the stream had cut a trench about ten feet deep.

First we gave our our attention to the stream. It contained but little water at this time; although we could see that it contained more in times of high water. Its bed was the horizontal shale rock, and upon this were scattered boulders which had been washed out from the drift and brought along by the stream. Its banks were steep and overhanging where the curve of the stream threw the water against them, while the opposite banks were low and shelved toward the water where tongues of new-made land had been deposited in the quieter eddies.

The stream was at work; and by setting sticks afloat we quickly saw the course of the water as it set now toward one bank, now toward the opposite one, in the smaller curves. This led us to observe the wider sweeps from side to side of the entire valley. About midway of the length of the gorge, it crossed completely from the base of one bluff to that of the other, with intervening smaller meanders. Upon the peninsulas thus formed were patches of vineyard, which showed us the agricultural value of the alluvial soil of the flood-plain. Where the stream touched the base of either bluff, there was a sheer ascent of the full height of the valley wall.

The stratified shales had been cut as with a knife; and so far had weathering progressed, that two active boys ascended half way to the top by digging their

heels into the soft material. From the face of the opposite bluff we obtained some fine photographs of the rain gullies upon its surface; and afterward a lantern slide was made for use in the schoolroom. This work was done by a pupil.

Continuing our journey, we ascended to the topmost level of the valley wall, by a road which was cut into the bluff. On one side of this road was a steep wooded slope to the stream, while on the other was the steep wall of shale, decreasing in height as we ascended. No figures could have given us the idea of the depth of the gorge which we got from the experience in climbing; and the pupils had but to reach out and handle the disintegrated shale and dig away the loosened fragments to the firm rock beneath, to see through what the stream had cut its way, and how the valley is still being widened by weathering. Finally we reached the top, and came out upon a plateau which stretched away with a slight rise to the upland far away against the southern horizon, where the sky-line was unbroken as far as the eye could see. Facing northward, we saw the stream far below, meandering across its flood-plain within the gorge and out across the plain beyond to the blue line of the lake on the northern horizon. Then, and only then could we appreciate the enormous quantity of material which even this little creek, insignificant in the great St. Lawrence system of drainage, had brought down.

The aneroid barometer had been set to zero at Euclid Avenue; and now we read it to see how deep the gorge was. This was the occasion of a lesson on the aneroid barometer and the method by which we obtained the result.

We returned through the valley again to the street cars at the avenue, and reviewed what we had seen in the light of the completed work. This exursion was made on a Saturday afternoon, the cost to those who went by street cars was twenty cents, and to those

who went on bicycles nothing; and all were at home before six o'clock.

The lesson on stream erosion was followed by two on the work of waves along the shores of Lake Erie.

We went first to Glennwood Beach, east of the city. Here there is a continuous beach one hundred feet wide and several miles long, including Glennwood, Villa, and Euclid Beaches, back of which rises a bluff of clay and sand to a height of forty feet.

First we noted the direction of the wind which was from the west, the prevailing direction along the lake; and also the angle at which the waves met the shore, about forty-five degrees.

Approaching close to the water's edge, we observed the zigzag course of the pebbles which were being moved along by the waves; and bits of wood were thrown in and traced for several rods down the beach. This gave us the general direction in which the lake moves the waste along the shore.

As far as we could see out under the shallow water were great beds of ripple marks in the sand. These we studied carefully by cutting them through with a stick and watching the waves fill the gaps again. The pupils had already noticed the ripple marks in the many stone sidewalks of the city; now the origin of those marks was understood. Back a few feet from the water was the well marked crest-line of the beach, sloping sharply toward the lake and more gently toward the base of the cliff. All the time we were walking along this ridge, studying its mode of formation and its direction parallel to the shore. Finally we walked close to the edge of the bluff. Here driftwood had been heaped by storms; and beneath the overhanging wall were many sea-caves. A storm of that very week had brought down great masses of clay large enough to fill a wagon; and some of the boys climbed to the top of the bluff and dislodged more. Then we could see how the shores of the lake are retreating, and how the owners of land there must

protect their property from the attacks of the waves by building sea-walls of stone or buttresses of wooden piling.

On the following Saturday we went to Edgewater Park, west of the city, and again studied the work of the waves there. The beach was similar, so that we could review the preceding lesson by seeing the same forces at work at another point.

At the extreme western end of the park, however, the beach ends abruptly against cliffs of shale which rise perpendicularly from the water. No finer example of a sea-cliff could be found along the lakes.

We were able to go along its base for a short distance, by walking up a narrow rock shelf; and a still lower shelf could be seen projecting out beneath the water. Sea-caves were abundant; and lying in them were heaps of rock fragments, the tools which the waves had used to hollow them out.

Here we used the clinometer, to see the slight eastward dip of the strata of shale; and the aneroid barometer gave us the height of the cliff. We also examined the thin layer of drift overlying the shale, and found drift boulders mixed with the fragments of native rock in the pebble beach.

About midway of the sand beach the shales disappeared, because they had been cut away by the Preglacial Cuyahoga, and the old valley had been filled with the delta sand.

Each of these excursions to the lake was attended by about one hundred pupils, the cost was inappreciable, and each occupied but a Saturday afternoon.

How much more profitable is it to know our home region, in such a way that we have only to go outside the walls of our school rooms, to see how the great physiographic processess have given to the lands their familiar form and outline? When we can do this, then shall we be prepared to see other regions with relation to their origin and development. New interest will be aroused in proportion as we gain power to interpret

their forms: and when we again go abroad in our own country and in others we shall look with eyes newly opened and minds alert to the wonders and beauties of this earth of ours.

LIST OF THE LAND AND FRESH WATER MOLLUSCA OF TUSCARAWAS COUNTY, OHIO.

BY DR. V. STERKI, NEW PHILADELPHIA.

The following list is the result of fifteen years' careful collecting. The number of species and forms found is a comparatively large one, especially if the fact is considered that our county has no lakes, ponds or extensive swamps.

This is not the place to enter upon controversies on questions of classification and nomenclature. Where names had to be changed, synonyms are added when desirable to secure the identity of a species. The generic name "Unio" has been retained for convenience. But there are, in fact, several genera well founded by characters of the soft parts, and also the shells. Numbers 105 to 116 will range under *Lampsilis*, 117 to 126 under *Quadrula*, 127 and 128 under *Unio* etc., 129 and 132 probably fall under different other genera.

Some species of the genera Ancylus, Physa, Amnicola and Goniobasis need a revision, and a few are, to all probability, new and unpublished.

Of special interest are, in first order: (No. 76) Planorbis rubellus Sterki, the types of which are from our county; (No. 81) Gundlachia, the occurence of which, in this vicinity, is of highest interest; (No. 128) Unio complanatus Sol., here for the first time found in the Ohio drainage, as to the writer's knowledge.

Mention may be made also of four well confirmed species of Pisidium the types of which were detected

in our county, and which are now known from a large part of the country.

The writer is working up the recent mollusca of Ohio. All communications, and the sending of materials from all parts of the state will be highly appreciated as they will help making the list of both forms and localities more complete and valuable.

NUMBER OF SPECIES.

Land Mollusca	62	
Fresh Water "Snails,"	42	
Gastropoda		104
Unionidæ	41	
Cycladidae	20	
Pelecypoda		61
Total number		165

1. *Polygyra albolabris* Say. Rather common. *var. minor.* A small, thin shelled form was found at New Philadelphia, on the bank along the river.
2. *Polygyra thyroides* Say. Rather common.
3. *Polygyra multilineata* Say. Not common, and generally rather small.
4. *Polygyra profunda* Say. Scarce; Goshen, Blicktown, on steep, wooded hillsides.
5. *Polygyra mitchelliana* Lea. Quite scarce; low grounds near New Philadelphia.
6. *Polygyra pennsylvanica* Green. Scarce; variable in color.
7. *Polygyra tridentata* Say. Common; rather variable in size; a number of specimens without any teeth on the peristome, collected at different places, seem to represent rather a deficient form than a variety.
8. *Polygyra fraudulenta* Pils. (fallax auctt. nec. Say, teste Pilsbry.) Not very common, albin specimens are found occasionally.
9. *Polygyra palliata* Say. Scarce.
10. *Polygyra inflecta* Say. Rather scarce.

11. *Polygyra monodon* Rack. *var fraterna* Say. Rather common.
12. *Polygyra hirsuta* Say. Common; rather variable in size; albin specimens were found at different places.
13. *Vallonia pulchella* Mull. Rather common. A form with milky-white, opaque shell was found at New Philadelphia.
14. *Vallonia excentrica* Sterkid. A few specimens in drift on the Tuscarawas river. (This is an eastern, and European species.)
15. *Pyramidula solitaria* Say. Rather scarce.
16. *Pyramidula alternata* Say. Not very common; a few reversed specimens were found.
17. *Pyramidula perspectiva* Say. Common.
18. *Pyramidula striatella* Anth. Common.
19. *Helicodiscus lineatus* Say. Common.
20. *Punctum pygmaeum* Drap. Common.
21. *Sphyradium edentulum* Drap. (Pupa edentula Drap., Vertigo simplex Gould.) Rather scarce. Some specimens are high with the last whorl wider, like some S. "alticolum Ingers., or var. gredleri Clessin.
22. *Strobilops labyrinthicus* Say. Not scarce.
23. *Strobilops virgo* Pils. Quite rare. On a hill (meadow) near New Phila.
24 *Leucochila fallax* Say. Rather scarce.
25. *Bifidaria corticaria* Say. Scarce.
26. *Bifidaria armifera* Say. Rather common.
27. *Bifidaria contracta* Say. Common.
28. *Bifidaria curuidens* Gld. Common. *Var. gracilis* Sterki. Scarce; New Phila.
29. *Bifidaria pentodon* Say. Not common. Specimens from damp places are usually low and short ovoid. (f. curta.)
30. *Vertigo gouldii* Binn. Rare: Goshen hill.
31. *Vertigo ovata* Say. Not very common.
32. *Vertigo ventricosa* Mse. Damp places, not rare.

Var. elatior Sterki. Larger and more elevated than ventricosa, with a rather acute apex; a strong callus in the palate, into which the palatal plicae merge, a strong, tooth-like lamella in the base. Although rather different from ventricosa, it seems to be connected by intermediate specimens. Seen from New York, Ohio, Michigan and West to Montana, while the type is found in the eastern part of country.

33. *Vertigo tridentata* Wolf. Rather scarce.
34. *Vertigo* (*Angustula*) *milium* Gld. Rather common.
35. *Cochlicopa lubrica* Mull. (Cionella, Ferussacia, subcylindrica Lin.) Not common.
36. *Circinaria concava* Say. (Macrocyclis c.) Rather common.
37. *Hyalinia fuliginosa* Griffith. Scarce.
38. *Hyalinia hammonis* Strœm (radiatula Ald., electrina Gld.) Common. Most specimens are mature before winter.
39. *Hyalinia wheatleyi* Bld. Rather scarce.
40. *Hyalinia* —? Near hammonis and wheatleyi; but seems to be distinct. Seen also from the southern Alleghanies and from Texas. One specimen near Midvale Station.
41. *Hyalinia indentata* Say. Rather common.
42. *Hyalinia ferrea* Mse. Very rare; Midvale.
43. *Hyalinia milium* Mse. Common.
44. *Zonitoides** *exignus* Stimpson. Common.
45. *Zonitoides minusculus* Binney. Rather scarce.
46. *Zonitoides læviusculus* Sterki. Rare. About a dozen dead shells were found in drift on the river after the high water of 1898. This is the most eastern known station of this species.

*Since the anatomy of this and the two following species is not known, their ranging under this genus may be doubted. And so it is with No. 48. which is ranged with Hy. ferrea for the similar appearance of its shell.

47. *Zonitoides nitidus* Mull. Not common.
48. *Zonitoides arboreus* Say. Very common; somewhat variable.
49. *Zonitoides intertextus* Binn. Not common.
50. *Zonitoides ligerus* Say. Common. The rather small variety also known from Pennsylvania and Michigan. Comparatively large specimens were collected at Stillwater.
51. *Zonitoides suppressus* Say. Rather scarce.
52. *Zonitoides multidentatus* Binn. Rare: Goshen.
53. *Conulus fulvus* Mull. Common.
54. *Conulus sterkii* Dall. Rare; Goshen. This is the smallest of our land shells.
55. *Limax campestris* Say. Common.
56. *Tebennohorus carolinensis* Bosc. Rather common and decidely variable in the color markings.
57. *Pallifera dorsalis* Binn. Rather scarce.
58. *Succinea retusa* Lea. (S. ovalis Gld.) Common and variable.
59. *Succinea?* Rare.
60. *Succinea avara* Say. Common. Decidedly variable in size, and the color of the shell.
61. *Carychium exiguum* Say. Common.
62. *Carychium exile* Ad. Common. Prefers dry, elevated situations.
63. *Limnaea columella* Say. Not rare.
64. *Limnaea palustris* Mull (elodes Say.) Common in some places. Most specimens have a strong, rose-colored lip when mature. Young, hatched in August, in a small aquarium, were fully grown by midwinter.
65. *Limnaea desidiosa* Say. Rather common, variable. Small, scalaroid specimens are found occasionally.
66. *Limnaea humilis* Say. Common.
67. *Limnaea?* Very rare.
68. *Planorbis trivolvis* Say. Rather common.
69. *Planorbis lentus* Say. Scarce. Doubtfully distinct from trivolvis.

70. *Planorbis briarinatus* Say. Common.
71. *Planorbis campanulatus* Say. Rare.
72. *Planorbis dilatatus* Gld. Common.
73. *Planorbis deflectus* Say. Rare.
74. *Planorbis umbilicatellus* Ckll. Not common, pools and ditches.
75. *Planorbis exacutus* Say. Not very common.
76. *Planorbis rubellus* Sterki. Rare. Stone Creek Valley near Odberts Station. (Also known from Michigan.)
77. *Planorbis parvns* Say. Common; variable in size, color and thickness of the shell.
78. *Plan. circumlineatus* Tryon. Rare. Small swamp south-east of New Philadelphia. Is considered by some conchologists, a var. of parvus, yet seems to be distinct.
79. *Planorbis hirsutus* Gld. Rare; swampy place of Ohio Canal. Closely resembling the European Pl. albus Mull.
80. *Planorbis* (Planorbula) armigerus Say. Common.
81. *Gundlachia* "*meekeana* Stimson? Agrees with g. californica."—Found in a pool, at Goshen Station, in April 1891 where about two hundred were collected. In November of the same year, and in April 1892, none could be found, and none since. Two specimens were collected in another pool, about two miles distant, in June 1894, and in November of the same year, a few young were found in the Tuscarawas river.
82. *Ancylus*—? Scarce in some pools of the Tuscarawas Valley.
83. *Ancylus diaphanus* Hald. Common, especially in the river. Variable: there are specimens with low and obtuse apex.
84. *Ancylus tardus* Say. Not very common, in the river and Stillwater Creek. Variable.

85. *Ancylus rivularis* Say. Very common especially in the river.

A var.(?) is larger and somewhat different in shape; scarce in pools.

86. *Ancylus*—? Not scarce, in the river. Only two millimeters long when mature, narrow, with the sides paralled, rather high. Has been filed, for years, under the M. S. name A. pumilus, and is evidently a distinct n. sp.

The North American Ancyli need a careful revision, with onatomic examination.

87. *Aplexa hypnorum* Lin. Scarce. Found near Midvale.

88. *Physa heterostropha* Say. Common and variable. An albin (perfectly colorless) specimen has been found. Var. gyrina Say. Common.

89. *Physa* —? Very small, seems distinct. Near Dennison.

90. *Physa* (? *ancillaria*) Tuscarawas river. Sugar Creek, Ohio Canal, etc. It has been identified as heterostropha, but is decidedly distinct as to shell and anatomy.

91. *Physa* —? Also doubtless a distinct species. The shell is like that of Aplexa hypnorum, for which it has been mistaken, but much smaller; the pallial fringes and the radul are those of a Physa. Has been noticed for years and was also received from other States. (Ms. name: Ph. aplectoides.)

92. *Campeloma integra* Say. Common. Inverse specimens are numerous. Some examples identified as C. rubra are not distinct.

93. *Somatogyrus isogonus* Say. River and Ohio Canal, rather scarce.

94. *Amnicola decisa* Hald. Rare.

95. *Amnicola orbiculata* Lea. Common in the river, race and Ohio Canal.

96. *Amnicola parva* Lea. Ohio Canal, notcommon.

97. *Amnicola cincinnatiensis* Anth. Ohio Canal, rare.
98. *Pomatipsis lapidaria* Say. Common in some places, as a rule away from water.
99. *Bithynella obtusa* Say. Ohio Canal, rather rare.
100. *Pleurcera labiatum* Lea. River, rare.
101. *Goniobasis livescens* Mke. "var lithasisides Lea". River, abundant.
102. *Goniobasis gracilior* Anth. var.—River, common and variable.
103. *Goniobasis depygis* Say. Little Still-water Creek.
104. *Valvata tricarinata* Say. Common.
105. *Unio ligamentinus* Lam. River, abundant; in many places outnumbering all other Unionidae combined. Rather variable in size, shape and color. One specimen was found in the canal.
106. *Unio rectus* Lam. Not common in the river; large; one specimen, female, is 184 milimeters long. The nacre is purple colored in the young, white in the adult.
107. *Unio luteolus* Lam. Common in the river and Creeks, large and beautiful in the Ohio Canal. Prefers quiet water and muddy bottom. A coarse, short form, very much inflated and badly eroded, in the Little Stillwater Creek.
108. *Unio ventricosus* Barnes. (U sulesvatus Lea, the male, U. occidens Lea, the female.) Rather common in the river, attaining a large size. In some, the nacre is rose colored. One shell has three large, well formed cardinal teeth in each valve. An interesting observation has been made on a large female specimen. Being under about ten inches of quiet, clear water, the posterior, prodruding parts of its mantle flaps were widely expanded and regularly undulating, waving, probably for the purpose

of producing an increased current of water over the branchiae.

109. *Unio multiradiatus* Lea. River, rather scarce.

110. *Unio iris* Lea. River, rather scarce.

111. *Unio novi-eloraci* Lea. River, not common. It still remains to be proved whether this species and the preceeding are identical or not.

112. *Unio fabalis* Lea. River, not scarce; the female average rather smaller than the male. In July 1893, an adult male was found with a byssus thread.

113. *Unio rangianus* Lea. River, rather scarce.

114. *Unio triangularis* Barnes. River, common.

115. *Unio parvus* Barnes. Scarce in the river, common in the canal.

116. *Unio circulus* Lea. It seems that this and U. lens Lea are identical, the latter corresponding with the female. Common in the river. The male is constantly much larger and heavier than the female.

117. *Unio tuberculatus* Barnes (verncos us Raf.) River and larger Creeks, rather common. The shell of the female is different from that of the male by an expansion of the posterior end.

118. *Unio undulatus* Barnes. River, Sugar Creek and Canal, common.

119. *Unio pustulosus* Lea. River, common, large, variable. Some specimens are almost covered all over with warts, others show hardly any.

120. *Unio verrucosus* Barnes. Scarce in the river, large and heavy.

121. *Unio coccineus* Hild. River and Sugar Creek, rather common; variable in shape and size. The larger specimens have some undulations below their middle. The nacre is white, or salmon colored to deep pink.

122. *Unio pyramidatus* Lea. River, not common. Some specimens with very large and heavy

shells. Color of the nacre white to deep pink. This and the preceeding species are closely related and yet constantly distinct.

123. *Unio rubiginosus* Lea. Common in the river and canal. Nacre milky white to salmon colored.

124. *Unio subrotundus* Lea. River, abundant, and very variable. In some specimens, the beaks are very prominent, even so that extreme forms resemble U. pyramidatus, while others are hardly distinguishable from large U. coccineus, in shape; the soft parts, however, and also the nacre are characteristic enough to separate them. The following are forms more remote from the type.

var kirtlandianus Lea. Little inflated, with the outlines subquadrate.

var.—Umbones very large and quite anterior; striae of growth coarse and regular; little connected with the type and found only in certain localities.

125. *Unio aesopus* Green. Frequent in the river a few miles above Canal Dover: scarce elsewhere.

126. *Unio clavus* Lam. River, not common.

127. *Unio gibbosus* Barnes. Common in the river; rare in the Ohio canal. Many old specimens are strongly curved downward in the posterior part. The female shells are more inflated, in the average, than the male.

F. arctior Lea. Not common; nacre white or salmon colored. Also specimens intermediate in color between the type and this form, which can not even be regarded as a variety.

128. *Unio complanatus* Sol. A single, large and well formed specimen was found in a mill race on the river, at New Philadelphia; the first instance of its having been collected in the Ohio drainage. This eastern species has evi-

dently migrated from the eastern rivers, by the canals, to Lake Erie, and from there over the divide (Summit Co., Ohio) by way of the Ohio canal, then into the Tuscarawas river.

129. *Unio cylindricus* Say. River, rare. One large and well formed specimen has none of the characteristic prominences along the umbonal ridge. Another is aberrant in coloration, having crowded, fine, dark green intermixed with few light green radial lines, and showing nothing of the characteristic pointed markings.

130. *Unio metanever* Raf. *var wardii* Lea. Sugar Creek and race on some at Canal Dover. Not a trace was found in the river.

131. *Unio phaseolus* Hildr. Common in the river and Sugar Creek, attaining a large size. The shell is very thick and heavy, comparatively. In the female, there is a deep, oblique sulens on the inner surface of each value, corresponding with the unluminous outer branches.

132. *Unio irroratus* Lea. Common in the river; nacre white to rose colored.

133. *Alasmodonta pressa* Lea. (U. pressus). River and Ohio Canal, scarce.

134. *Alasmodonta rugosa* Barnes. (Margaritona rugosa). Common in the river; Sugar Creek; scarce in the canal.

135. *Alasmodonta complanata*. Barn. Scarce and small in the river. Common and quite large in the Ohio Canal. Still water Creek.

136. *Alasmodonta marginata* Say. River, rather common.

137. *Alasmodonta deltoidea* Lea. River and Ohio Canal, rather common.

138. *Alasmodonta hildrethiana* Lea. River, quite scarce.

139. *Alasmodonta dehiscens* Say. River, rather scarce.

140. "*Anodonta*" *edentula* Say. Common in the river; creeks; scarce in the canal.

141. "*Anodonta*" *ferussaciana* Lea. River and canal, scarce.

No's. 140 and 141 are no true Amodontae, and Iwill be ranged under another genus.

142. *Anodonta grandis* Say. Clay pit pools at New Philadelphia; one specimen was 7½ inches long.

143. *Anodonta salmonea* Lea. River and canal, common.

144. *Anodonta decora* Lea. Little Still-water Creek, near Dennison.

145. *Anodonta imbecillis* Say. River, creeks, races, canal. Most specimens have characteristic undulations in the middle of the valves. In young examples, the glochidium shell is distinctly visible in the center of the umbones. The animal is hormaphroditic!

146. *Sphaerium simile* Say. Few places.

147. *Sphaerinm striatinum* Lam. Common in the river, creeks and races; variable.

148. *Sphaerium stamineum* Con. Abundant in the same waters with the preceeding. Variable, especially as to striation.

149. *Sphaerium fabale* Pr. Nimishillen creek; not yet found in the river.

150. *Sphaerium rhomboideum* Say. Ditch from a small swamp southeast of New Philadelphia.

151. *Sphaerium occidentale* Pr. Rather common in pools and ditches, scarce in the river and canal. It has been found in large numbers, llving and propagating, in low grounds of the Tuscarawas valley, under wood, dead leaves, etc., where water was standing only during freshets, a few days in a year; a small form with strongly marked lines of growth.

152. *Calyculina transversa* Say. Common in the river and canal.

153. *Calyculina partumeia* Say. In pools and ditches, common, small. It is noteworthy that almost every place has its own, rather constant form. Yet a part may be distinct.

154. *Calyculina securis* Pr. var cardissa Pr. (teste Roper). Pools and ditches, less common than the preceeding. A large, strongly inflated form, usually of a vivid yellow, the surface dull; variable.

155. *Pisidium compressum* Pr. Common in the river, creeks, races and the canal, and in pools filled by freshets; variable in shape and striation.

156. *Pisidium fallax* Sterki. River and creeks, rather common.

157. *Pisidium cruciutum* Sterki. River, rather common. One of the most characteristic of all Pisidia.

158. *Pisidium punctatum* Sterki. River, not rare; most specimens typical, with ridges on the beaks. The smallest of our species.

159. *Pisidium variabile* Pr. Rather scarce, in different places.

160. *Pisidium nov-eboracense* Pr. Spring-brooks, ditch from swamp; rare in the river.

161. *Pisidium sargenti* Sterki. Rather scarce.

162. *Pisidium walkeri* Sterki. Side-cut on mill race, not common, but very good, typical specimens.

163. *Pisidium abditum* Hald. Ditches and pools, common and variable.

164. *Pisidium politum* Sterki. Common in ditch from swamp, where the types were found, mill race and other places.

165. *Pisidium splendidulum* Sterki. Ditches, not common.

(All these Pisidia are good, well characterized species, and distributed over a large part of the country).

REPORT OF THE STATE HERBARIUM.

BY W. A. KELLERMAN, OHIO STATE UNIVERSITY.

The State Herbarium in charge of the Botanical Department of the Ohio State University, has been steadily growing for six years and now includes over ten thousand mounted sheets of phanerogans and vascular cryptogams. It contains also a large number of specimens of the lower plants, but these are only partially mounted and arranged and not as yet counted. The incorporation into the herbarium of a large number of specimens collected recently is now being rapidly carried on. While the author's labor on this State collection may be indicated to some extent by the fact that his name as collector occurs on the labels of nearly four thousand of the higher plants and many of those of the lower plants, it must be understood that assistance has been rendered by a large number of persons throughout the State, and sincere thanks for these important contributions are hereby tendered.

The herbarium of the late Joseph F. James was purchased by the State University, and that collection furnished about five hundred and fifty specimens for the State Herbarium. The next largest collector so far represented is Mr. Wm. C. Werner, formerly an assistant in the Botanical Department. Previous to the past season the persons contributing over one hundred specimens were, Mrs. [illegible]. J. Spence (354 specimens), E. L. Fullmer (346), E. Wilkinson (310), E. E. Bogue (309), Ed Claassen (299), A. Wetzstein (273), E. L. Mosely (222), J. A. Sanford (160), Wm. Krebs and Claassen (136), H. Jaske (131), W. H. Aiken (112), and J. S. Vandewoort (105).

During or at the close of the season of 1899 the following persons have made large and important donations: Albert Ricksecker (Oberlin), Thos. Bonser (Carey). A. Wetzstein (St. Marys) E. V. Louth (Ashtabula), W. W. Stockberger (Granville). Clara M. Tangeman (New Bremen), Otto E. Jennings (Olena), Wm. Krebs (Cleveland), F. J. Tyler (Perry), C. A. Miner (Bristolville), H. J. Winkler (Dayton). W. H. Aiken (Cincinnati), A. D. Selby (Wooster), A. H. Snyder (Paris), and L. C. Riddle, R. E. Griggs, J. H. Schaffner and E. L. Fullmer (Columbus).

It is hoped that during the next year even larger donations may be made.

The specimens of several important genera have been critically examined by specialists, thereby largely enhancing the value of the collection. This is true, for example, of Crataegus, Salix, Asarum, Antennaria, Euphorbia, Aster, Panicum, Hicoria, etc.

It is designed that this collection shall thoroughly and completely illustrate the distribution of every species in the state and be so rich in specimens that variations due to any and every cause will be fully exhibited. Continuous annual increase should also show promptly the introduction of additional species from abroad and the escaped species as soon as they get clearly beyond cultivation.

It is needless to add that this Herbarium is open to all the people of the State. to whom in fact it belongs, and who it is confiidently hoped, will avail themselves of its usefulness even more largely in the future than in the past.

REPORT ON RAIL ROAD WEEDS.

BY L. D. STAIR, MANSFIELD OHIO.

Plants growing where they are not desirable to man, are called weeds. Many plants which under

certain conditions are most useful may under other circumstances, be exceedingly harmful. For instance, wheat is one of the most useful of all plants, but along the railroad it may be a nuisance. Railroad weeds are those plants which grow in sufficient abundance along the railroad either along the right of way or in the ballasted track to be troublesome in getting rid of them.

Weeds may be either native plants or introductions from Europe, Asia, Africa or South America. Often the primary introcuction of the seeds of these introduced weeds is a puzzle, whether in vegetables, fruits, seeds, grains or animals imported from these countries. The most likely way is in packages of seeds or grains. As a general thing, native plants which have become weeds do not cause nearly so much trouble as the introduced species. These latter spread for the first few years with amazing rapidity, due to changing and bettering of conditions of growth and lack of enemies. Then later parasitic fungi, insects and animals find them suitable as host-plants or food. Thus in time, as they become naturalized the conditions about balance each other.

Weeds compared to ordinary plants bear enormous quantities of seed. Most of them do not depend upon insects for the polination of their flowers. They depend upon themselves for fertilizing and producing their seed. Ingenious means for the distribution of seed, suiting various locations and circumstances, are provided by many weeds.

To the farmer, weeds are injurious; first, by robbing cultivated plants of moisture light, space and food-elements; second, by harboring injurious fungi and insects; last, by the rendering of wheat, rye, oats etc., unmarketable on account of weed-seeds mixed with the grain.

In talking about railroad weeds, one must first explain that those plants which are weeds to the farmer are not necessarily to be considered weeds to

the railroad for some of the cultivated plants of the farmer are a railroads worst weeds. For in general all plants which occasion expense of any kind to a rail road company are its weeds. These observations have only extended over a period of two years and over the North-eastern and Eastern central portion of Ohio. There is attached a list of about three hundred plants which come under the head of railroad weeds.

For convenience of example they may be divided into three groups, which are quite as distinctly marked as the flora of a bog, a rich woods or a lake-beach. These three groups comprise first ; plants growing on the track proper in the ballast, giving a very bad appearance ; and railroads try to get rid of at least these weeds : second, plants growing in the ditches thereby causing improper drainage. These have to be dug out or hoed out in order to give an unimpeded flow of water ; third, the weeds growing on the property between the track and the fences. These are the weeds that you see growing by any roadside and are simply cut down with scythe or brush-hook.

Of all plants growing in the track wheat, brideweed, ephorbias and foxtail grass give the most trouble. In the ditches the lime-forming algae (notably species of Chara) and the various species of Polyganum are particularly bad.

The conditions of track and track ballast vary so greatly from 'crushed stone, slag, ashes, cinder to gravel and dirt that the amount of weeds in the ballast depends greatly on its character. Of these various kinds of ballast, the smallest number of weeds grow in slag and cinder ballast and the greatest in dirt. When I tell you that the expense to some of the railroads in getting rid of their weeds amounts to as much as $140.00 per mile per year then you can see it is a matter of some importance. If an average of $50.00 per mile per year is taken. and since the mileage of main track in Ohio alone is 9000 miles (exclusive of all side tracks). the total cost per year to railroads in

Ohio is over a half million dollars, and this is a very moderate estimate. On some roads it takes 20 per cent. of section-men's time to attend to weeds. I have a number of letters from supervisors giving the cost due to weeds in terms of the distance and time. And all this expense simply for appearance sake.

To the railroad, weeds only effect the aesthetic side. The unsightly, unkept appearance of weeds is general along all highways, canals aud railroads. The direct injury to the materials of a railroad due to weeds is trifling, except one called fungi and other cryptogamic life weeds. Fungi hasten the life of ties, but this is small compared to the destruction caused by the alternate expansion and contraction of the wood-fibres when wet or dry, and the freezing of water in the pores in winter, thus bursting the wood-cells.

In the North-eastern part of the United States, the portion included between 100th meridian and the Atlantic, and Canada and Tennessee, there are about 3,300 species of seed plants. Of this number 2,900 are native and 400 introduced. Of these 400 introduced plants, perhaps 75 per cent. may be classed as weeds. The proportion of native plants which are weeds is not more than 10 per cent. The number of species of all plants growing in Eastern Ohio might reach 1,500, of this number nearly 300 are weeds, in the railroad sense.

The seeds of these foreign stragglers are brought in various ways ; packages of vegetable and flower seeds, in clover, grass and grain seed. Seeds with prickly coatings, like burdock, become attached to the fur of animals and carried in wool. Seeds with glutinous coverings are carried by the feet of birds. Many hard-coated seeds not ground up in the food of animals and not attacked by their digestive organs and spread in their dung.

Western hay, straw and grains bring many western and prairie forms to the east and vice versa.

Other seeds are spread by the wind, like dandelion, having hair-like parachutes which render them buoyant. Others are provided with membranous wings Some, for instance the tumble-weeds, distribute their seeds by curling into ball form, when dry In the fall breaking off near the root and are blown about here and there by the wind, scattering seeds as they go. Russian thistle is an example of this. The heads of some grasses, like old-witch-grass, have this same peculiarity. Some plants retain their seed until snow is on the ground and then the wind blows the seed over the surface of the snow. Along the railroad, weeds are also scattered by dirty stock-cars, by cattle and in hay and straw. Leaky grain-cars drop much seed. On the slow track on grades, especially the eastbound track bringing grains from the west, there is usually a mat of weeds, grains, etc. This is natural, as the trains running slow do not blow away the seed dropped by them.

The question of the destruction of weeds is much easier to speak about than to carry out. The prevention of the introduction of weed-seeds can hardly be accomplished. It would be recommended, however, that all stock, vegetable and hay cars be thoroughly cleaned and kept clean ; to be only cleaned at certain specified places, at division termini. All refuse hay, manure and dirt should be burned at these points. Grain cars should be carefully watched at time of loading to prevent leakage and kept in good repair. Perennial weeds, especially those with underground stems or large roots, must be kept cut close to the ground to starve out the underground part. The taking away of the leaves, deprives the plants of the carbon dioxide of the air and so starves them out gradually. Salt, kerosene, strong sulphuric or hydrochloric or carbolic acid may be used with most excellent result on the more pernicious ones growing in patches.

Weeds caused by certain conditions of the soil,

may be controlled by the removal of the condition, such as marsh plants, by better drainage. Many perenniats—Canada thistle, horse-nettle and field bindweed—must not be removed by the cutting out of the roots as it only increases the difficulty as each separate piece of underground stem will produce new plants. Chemicals would be the best remedy in these cases. Weeds should be cut while in bud and then be burned. Any mature plants should always be burned. To burn weeds, they should first be carried to a barren spot so that the burnt ground will not give an unsightly appearanco to the sodded banks, care being taken that the fire is not allowed to extend to fences or adjoining land. Weeds pulled from the ballasted track, should be put together and carried away and not thrown onto the right of way banks.

Some railroads that are not parlicular about the neat appearance of their right of way and wish to cut their weeds as cheaply as possible, attach steel cutters to the wings of a snow plow or to special appliances. This is hauled by a locomotive and can clean twenty to twenty-five miles of track a day with four men, two to extend or close the wings and two to raise and lower the cutters at crossings and switches.

The Sheffield weed-cutting hand-car is used effectively on many roads and with five or six men can cut four or five miles per day. Brine, gasoline or oil-burners, and steam jets are among the means experimented with by railroads in this direction. In experiments with electricity on the Illinois Central, a brush 10ft. long and 4 ins. wide was made of fine bare copper wire and suspended from the flat car, so that it would always touch the ground. Another car contained an engine, dynamo, transformers, etc., steam being taken from the locomotive. The cars were run at a speed of five miles an hour and two trips were found sufficient to kill all the vegetation, an advantage of this process being that all the roots were absolutely killed. The brush was in short sections,

insulated one from the other, so that all the current would not be discharged though any one weed. A current of ten thousand volts was found to be most satisfactory.

Burning weeds with jets from burners using crude oil and compressed air. has been tried on the Minneapolis, St. Paul and Sault Sainte Marie Railroad. This apparatus was mounted on a self-propelled flat-car and could work over ten miles a day consuming fifteen to twenty gallons of oil per mile. A strong solution of brine, delivered from a sprinkling attachment on a water tank car was used at one time on the Atchison, Topeka and Santa Fe Railroad. It effectually killed the weeds, but care had to be taken not to let the brine get on the rail, or it would cause a slime on the rails which led to slipping of the engine wheels and a subsequent corrosion of the rail. The Ohio River Railroad has used a sprinkler using refuse oil, to kill its weeds. It cost about $80.00 per mile, one sprinkling being sufficient for one season. This method was also effective in laying the dust. The use of oil would be for double-track about 1½ times as much as this or about $120.00 a mile.

LIST OF THE FIFTY WORST WEEDS IN ORDER.

F. M. W.

1. Field Bindweed.
2. Prickly Lettuce.
3. Foxtail.
4. Ragweed.
5. Spotted Spurge.
6. Horse-tail.
7. Yarrow.
8. Horse-nettle
9. Scouring-rush.
10. Old-witch Grass.

26. Cocklebur.
27. Knotweed.
28. Sweet Clover.
29. Carpet-weed.
30. Nettle.
31. Milkweed.
32. Barnyard Grass.
33. Horse weed.
34. Canada Thistle.
35. Mallow.

11. Wild Parsnips.
12. Black Plantain.
13. Nut Spurge.
14. Burdock.
15. Butter and Eggs.
16. Bouncing Bet.
17. Common Thistle.
18. Clearlock.
19. Dandelion.
20. Mullein.
21. Dock.
22. Pigweed.
23. Lamb's-quarters
24. Tumbleweed
25. Plantain.
36. Teasel.
37. Pokeweed.
38. Sorrel.
39. Stinking grass.
40. Couch-grass.
41. Sow-grass.
42. Corn Gromwell.
43. Mint.
44. Sow Thistle.
45. Catnip.
46. Jimson-weed.
47. Mayweed.
48. Russian Thistle.
49. Wild Carrot.
50. Bur-grass.

LIST OF CULTIVATED PLANTS GROWING IN RIGHT OF WAY IN ORDER OF THEIR ABUNDANCE.

1. Wheat.
2. Rye.
3. Mustard.
4. Timothy.
5. Oat.
6. Hop.
7. Asparagus.
8. Horseradish.
9. Bean.
10. Flax.
11. Buckwheat.
12. Strawberry.
13. Corn.
14. Barley.
15. Pumpkin.
16. Tomato.
17. Hemp.
18. Potato.
19. Watermelon.
20. Cucumber.
21. Squash.

A FEW OF THE LESS COMMON WEEDS FOR EAST OHIO.

Sisymbrium altissimum.
Camelina sativa.
Vaccaria vaccaria.
Conringia orientale.
Papaver rhoeas.
Trifolium arvense.
Trifolium incarnatum.
Silphium terebinthaceum.
Rudbeckia fulgida.
Echium vulgare.
Hedeoma hispida.
Salsola kali.
Yucca filamentosa.

SCIENTIFIC NAMES.

Dryopteris noveboracensis, (L.) A. Gray.
Dryopteris thelypteris, (L.) A. Gray.
Pteris aquilina, L.
Equisetum arvense, L.
Equestum fluviatile, L.
Equestum hyemale, L.
Equestum robustum, Brown.
Typha latifolia, L.
Potamogeton sp. ——
Alisma Plantago-aquatica, L.
Sagittaria sp. ——
Andropogon scoparius, Michx.
Andropogon furcatus, Muhl.
Anropogon virginicus, L.
Syntherisma sanguinalis, (L.) Nash.
Panicum crus-galli, L.
Panicum dichotomum, L.
Panicum capillare, L.
Ixophorus glaucus, (L.) Nash.
Cenchrus tribuloides, L.
Homalocnchrus oryzoides, (L.) Pool.
Muhlenbergia sp. ——
Phleum pratense, L.
Avena sp. ——
Danthonia spicata, (L.) Beau.
Sporobolus sp. ——
Elesuine indica, (L.) Gaertn.
Eragrostis major, Host.
Eragrostis purshii, Schrad.
Dactylis glomerata, L.
Poa compressa, L.
Panicularia sp.——
Festuca elatior, L.
Bromus secalinus, L.
Bromus tectorum, L.
Lolium perenne, L.
Agropyron repens, (L) Beau.

Hordeum jubatum, L.
Cyperus rivularis, Kunth.
Cyperus erythroshizos, Muhl.
Cyperus strigosus, L.
Eleocharis sp.——
Scirpus atrovirens, Muhl.
Scirpus lacustris, L.
Scirpus cyperinus, (L) Kunth.
Carex sp.——
Tradescantia virginica, L.
Pontederia cordata, L.
Juncus sp.——
Hemerocallis fulva, L.
Allium canadense, L.
Liluim canadense, L.
Yucca filamentosa, L.
Asparagus officinalis, L.
Smilax rotundifolia, L.
Saururus cernuus, L.
Humulus lupulus, L.
Cannabis sativa, L.
Urtica gracilis. L.
Adicea pumila, (L) Raf.
Boehmeria cylindrica, (L.) Willd.
Comandra umbellata, (L.) Nutt.
Rumex acetosella, L.
Rumex crispus, L.
Rumex obtusifolius, L.
Rumex verticillatus, L.
Fagopyrum fagopyrum (L) Karst.
Polygonum pennsylvanicum, L.
Polygonum persicaria, L.
Polygonum hydropiper, L.
Polygonum hydropiperoides, Mx.
Polygonum aviculare, L.
Pylygonum erectum, L.
Polygonum convolvulus, L.
Polygonum scandens, L.

Polygonum arifolium, L.
Polygonum sagittatum, L.
Chenopodium album, L.
Chenopodium glaucum, L.
Chenopodium botrys, L.
Chenopodium ambrosioides, L.
Atriplex hasta, L.
Salsola tragus, L.
Amaranthus retroflexus, L.
Amaranthus hybridus, L.
Amaranthus graecizans, L.
Amaranthus blitoides, Watson.
Phytolacca decandra, L.
Mollugo verticillata, L.
Portulaca oleracea, L,
Agrostemma githago, L.
Silene antirrhina, L.
Silene noctiflora, L.
Saponaria officinalis, L,
Vaccaria vaccaria, (L.) Britt.
Alsine media, L.
Crastium vulgatum, L.
Nymphaea advena, Soland.
Caltha palustris, L.
Ranunculus abortivus, L.
Ranunculus sceleratus, L.
Ranunculus septentrionalis, Poir.
Rauunculus acris, L.
Thalictrum sp. ——
Podophyllum peltatum, L.
Papaver rhoeas, L.
Chelidonium majus, L
Lepidium virginicum, L.
Thlaspi arvense, L.
Sisymbrium officinale, (L.) Scop.
Sisymbrium altissimum, L.
Sinapis alba, L.
Brassica nigra, (L.) Koch.

Brassica arvensis, (L.) B. S. P.
Barbarea stricta, Andrz.
Roripa palustris, (L.) Bess.
Roripa nasturtium, (L.) Rusby.
Roripa armoratia , (L.) A. S. Hitchock.
Bursa bursa-pastoris, (Britt.)
Camelina sativa, [L.] Crantz.
Hesperis matronalis, L.
Erysimum orientale, R. Br.
Sedum telephium, L.
Penthorum sedoides, L.
Heuchera americana, L.
Spiraea salicifolia, L.
Rubus villosus, Ait.
Rubus Canadensis, L.
Fragaria sp. ——
Potentilla monspeliensis, L.
Potentilla canadensis, L.
Agrimonia hirsuta, [Muhl.] Bick.
Agrimonia parviflora, Soland.
Rosa humilis, Marsh.
Rosa carolina, L.
Rosa rubiginosa, L.
Medicago lupulina, L.
Melilotus officinalis, [L.] Lam.
Melilotus alba, Desv.
Transfolium incarnatum, L.
Transfolium arvense, L.
Transfolium pratense, L.
Transfolium repens, L.
Transfolium hybridum, L.
Meibomia sp. ——
Falcata comosa [L.] Kuntze.
Phaseolus sp. ——
Geranium maculatum, Town.
Oxalis stricta, L.
Linum usitatissimum, L.
Acalypha virginica, L.

Euphorbia maculata, L.
Euphorbia nutans, Lag.
Euphorbia corollata, L.
Euphorbia cyparissias, L.
Rhus radicans, L.
Impatiens fulva, Nutt.
Impatiens aurea Muhl.
Vitis vulpina, L.
Vitis cordifolia, Mx.
Parthenocissus quinquefolia, [L.] Planch.
Malva rotundifolia, L.
Abutilon abutilon, [L.] Rusby.
Hypericum perforatum, L.
Hypericum maculatum, Walt.
Lythrum alatum, Pursh.
Epilobium? Muhl.
Onagra biennis, [L.] Scop.
Gaura biennis, L.
Circaea lutetiana, L.
Daucus carota, L.
Angelica atropurpurea, L.
Oxypolis rigidus, [L.] Britt.
Heracleum lanatum, Mx.
Pastinaca sativa, L.
Syrans cicutaefolium, Gmel.
Cicuta maculata, L.
Cicuta bulbifera, L.
Anthriscus crefolium, (L.) Hoffm.
Lysimachia quadrifolia, L.
Lysimachia nummularia, L.
Steironema ciliatum, [L.] Raf.
Apocynum androsaemifolium, L.
Apocynum cannabinum, L.
Asclepias tuberosa, L.
Asclepias incarnata, L.
Asclepias syriaca, L.
Ipomoea pandurata, [L.] Meyer.
Ipomoea purpurea, [L.] Roth.

Convolvulus sepium, L.
Convolvulus arvensis, L.
Cuscuta gronovii, L.
Cynoglossum officinale, L.
Lithospermum arvense, L.
Lappula virginica, (L.) Greene.
Echium vulgare, L.
Verbena sp. ——
Teucrium hanadense, L.
Marrubium vulgare, L.
Nepeta cataria, L.
Glechoma hederacea, L.
Prunella vulgaris, L.
Leonurus cardiaca, L.
Lamium amplexicaule, L.
Stachys sp. ——
Hedeoma pulegioides, [L.] Pers.
Hedeoma hispida, Pursh.
Clinopodium vulgare, L.
Lycopus sp.
Mentha spicata, L.
Mentha piperita, L.
Physalis pubescens, L.
Physalis virginiana, Mill.
Physalis heterophylla, Nees.
Solanum nigrum, L.
Solanum carolinense, L.
Solanum dulcamara, L.
Solanum tuberosum, L.
Lycopersicon lycopersicon [L.] Karst.
Lycium vulgare, [Ait. f.] Dunal.
Datura tatula, L.
Datura stramonyrous L.
Verbascum thapsus, L.
Verbascum blattaria, L.
Linaria linaria [L.] Karst.
Pentstemon hirsutus [L.] Willd.
Mimulus sp.

Dysanthes gratioloides [L.] Benth.
Gratiola virginiana, L.
Veronica americana, Schw.
Veronica officinalis, L.
Veronica peregrina, L
Tecoma radicans, (L.) D. C.
Plantago rugelii, Dec.
Plantago major, L.
Plantago lanceolata, L.
Galium sp.
Sambucus sp.
Valerianella sp.
Dipsacus sylvestris, Mill.
Cucurbita sp.
Cucumis sp.
Citrullus sp.
Sicyos angulatus, L.
Micrampeles lobata, [Mx.] Green.
Legonzia perfoliata, [L.] Britt.
Lobelia syphilitica, L.
Lobelia inflata, L.
Cichorium intybus, L.
Tragopogon parrifolius, L.
Taraxacum taraxacum [L.] Karst.
Sonchus oleraceus. L.
Sonchus asper, [L.] All.
Lactuca scariola, L.
Lactuca canadensis, L.
Lactuca spicata (Lam.) Hitch.
Ambrosia trifida, L.
Ambrosia artemisiæfolia, L.
Xanthium canadense. Mill.
Vernonia sp.
Eupatorium purpureum, L.
Eupatorium perfoliatum, L.
Kuhnia eupatorioides, L.
Solidago sp.
Aster sp.

Erigeron philadelphicus, L.
Erigeron anus, [L,]Pers.
Erigeron ramosus (Walt) B. S. P.
Leptilon canadense (L) Britt.
Antennaria plantaginifolia, (L) Rich.
Gnaphalium obtusifolium L.
Inula helenium, L.
Silphium perfoliatum, L.
Silphium trifoliatum, L.
Silphium terebinthaceum, L.
Heliopsis helianthoides (L) B. S. P.
Rudbeckia hiita, L.
Rudbeckia fulgida, Ait.
Rudbeckia lacinata, L.
Ratibida pinnata (Vent) Barn.
Helianthus sp.
Verbesina alternifolia (L) Britt.
Coreopsis tripteris, L.
Bidens cernua, L.
Bidens connata, Muhl.
Bidens frondosa, L.
Bidens bipinnata, L.
Bidens trichosperma (Mx) Britt.
Galinsoga parviflora, Cav.
Helenium autumnale, L.
Achillea millefolium, L.
Anthemis cotula, D. C.
Chrysanthemum leucanthemum, L.
Tanacetum vulgare, L.
Erechtites hieracifolia, (L) Raf.
Mesadenia atriplicifolia, (L) Raf.
Senecio aureus, L.
Arctium sp.
Carduus lanceolatus, L.
Carduus muticus, [Mx.] Pers.
Carduus arvensis, (L) Robs.
Centaurea cyanus, L.

REMARKS ON THE HEMIPTEROUS FAUNA OF OHIO WITH A PRELIMINARY RECORD OF SPECIES.

HERBERT OSBORN, OHIO STATE UNIVESITY.

If there is any need of an apology for the study of a local fauna it would seem to be sufficient to call to mind the numerous problems in geographical distribution, life zones and dispersal which are presented by every group of animals and for the solution of which complete records of local faunae become indispensable. At first sight it may seem less essential to secure such records for the different parts of a large area having primarily one faunal zone but the facts reveal that in many cases the distribution of particular species presents peculiar limitations, and the recognition of these is essential in any consideration of more general groups. While the study of remote and exceptional localities may give more striking and immediate returns an extended and systematic study of particular groups must be the basis for final conclusions regarding many of the more obscure laws. Such a study as has been made of the *Odonata* in this state by the lamented Prof. Kellicott is a good example of what is needed in other groups.

The present paper is admittedly incomplete, in fact, is presented simply as a preliminary to the study of this fauna which it is expected to pursue and its purpose is to interest, if possible, collectors in different parts of the state, without whose assistance the work must necessarily be very slow. We may safely assume that the fauna of the state will present some marked differences if we compare the area bordering the lake

shore, the elevated south eastern part and the south-western valley portion and it is particularly desirable to accumulate material from these different areas. It is hoped that we may be able to give a careful survey to these areas as well as the central part of the state within the next few years but collections from any parties especially in these areas will be most thankfully received.

But little labor is necessary in the collecting or preparation for sending. The greater number are easily caught in a sweep-net from grass and low herbage; and the bush and tree inhabiting species by beating over an umbrella. As soon as killed in the cyanide bottle they may be packed in pill boxes between sheets of tissue paper and then they are ready for transmission by mail or for indefinite preservation—the work of sorting, separating species and mounting being done at any convenient time. Date of capture and the food plant if possible of determination should accompany each lot as these add immeasurably to the value of the collection.

Aside from the few months work which has been possible to me, the University collections contain a number of species collected by Mr. Hine and these furnish the basis for the preliminary record here presented.* Aside from records made by Prof. C. M. Weed of *Aphididæ* and of various injurious species by Prof. Webster scarcely any records occur in literature, the only one of Say's species which can be counted as referred to the state being one which is given for "near Lake Erie and in Indiana."

The list as it stands however may serve to show the general nature of the fauna and as a basis for future additions. The number will certainly be largely increased by another season's collection.

*As the printing of this paper was deferred from last Annual Report it has been possible to add a number of records made during the season of 1899.

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ıb. Sandusky, Georgesville,

Harr. Columbus (?) Usually
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g. Reported by Prof. Webster
›n *Ampelopsis quinquefolia* at

›dg. Jeffersonville.
Stal. Wauseon. Usually rare on

ab. Columbus. Sometimes occurs
ce.
. Columbus, Abundant.
ratus Fitch. Columbus. Rare.
Say. Columbus, Wauseon. On Oaks.
·eatus Say. Columbus.
ae Th. Ashtabula, On Chestnut.
Fitch. Sandusky, Newark, Columbus.
.nt on oaks and may sometimes be
n large numbers on grass or other plants
h oak trees.
·alamandra Fairm. Columbus. Usually
r rare. Hanging Rock, 5, 29, '99.
arquata Say. Columbus. Abundant on
k Locust.
mera Say. Columbus. A common species
wide range in U. S. On Hickory.
ı binotata Fab. Columbus, Georgesville.
›mmon on thistles and other weeds.
nchia curvata Fab. Columbus, Castalia.
Abundant over large part of U. S. Feeds as

HOMOPTERA.

CICADIDAE.

Cicada tibicen Linn. Columbus. Common, widely distributed.

Cicada pruinosa Say. Columbus.

Tibicen septem decem, L. "Seventeen year cicada". Represented by different broods in various parts of the state.

Tibicen rimosa, Say (?) Probably one of the varieties of this species.

MEMBRACIDAE.

Entilia sinuata, Fab. Columbus. Usually rare. Occurs on wild sunflowers and other weeds.

Publilia concava, Say. Columbus. Hanging Rock. Often abundant. Occurs in colonies on Helianthus and other compositae.

Ceresa diceros, Say. Columbus, Sandusky, Castalia, abundant on various plants, especially in woods.

Ceresa bubalus, Fab. Colnmbus, Castalia, Sandusky. Widly distributed, abundant. Often injurious to orchard trees.

Ceresa basalis Walk. (?) Medina. Fairly common in northern U. S.

Thelia bimaculata Fab. Columbus. Common on Black Locust.

Thelia uhleri, Stal. No locality. Not rare in various parts of northern U. S.

Thelia crataegi Fitch. Columbus. Usually rather rare. Occurs on thorn.

Contributions from the Department of Zoology and Entomology Ohio State University, No. 2.

Thelia turriculata Emmons. "Ohio" (Kellicott vide Goding).

Thelia univittata Harr. Sandusky.

Thelia godingi VanD. Wauseon (Hine), Van Dugee. Credit it to black cherry and scrub-oak.

Telamona reclivata Fitch. Wauseon. Food plant basswood.

Telamona monticola Fab. Sandusky, Georgesville, Fairly common.

Telamona ampelopsidis Harr. Columbus (?) Usually common on *ampelopsis*.

Telamona concava Fitch. Columbus.

Telamona fasciata Fitch. Columbus. Common.

Telamona spreta Godg. Reported by Prof. Webster as occuring on *Ampelopsis quinquefolia* at Wooster.

Heliria strombergi Godg. Jeffersonville.

Archasia beltragei Stal. Wauseon. Usually rare on Oak.

Similia camelus Fab. Columbus. Sometimes occurs in abundance.

Acutalis calva Say. Columbus. Abundant.

Cyrtolobus fenestratus Fitch. Columbus. Rare.

Cyrtolobus vau Say. Columbus, Wauseon. On Oaks.

Cyrtolobus trilineatus Say. Columbus.

Atymna castaneae Th. Ashtabula. On Chestnut.

Atymna querci Fitch. Sandusky, Newark, Columbus. Abundant on oaks and may sometimes be found in large numbers on grass or other plants beneath oak trees.

Ophiderma salamandra Fairm. Columbus. Usually rather rare. Hanging Rock, 5, 29, '99.

Vanduzea arquata Say. Columbus. Abundant on Black Locust.

Carynota mera Say. Columbus. A common species of wide range in U. S. On Hickory.

Enchenopa binotata Fab. Columbus, Georgesville. Common on thistles and other weeds.

Campylenchia curvata Fab. Columbus, Castalia. Abundant over large part of U. S. Feeds as

larva on clover and probably many other plants.

Microcentrus caryae Fitch. Common on hickory. Northern U. S. Adults in August.

FULGORIDAE.

Scalops sulcipes Say. Castalia. Ranges over U. S. east of Rocky Mountains. On grassy lowland.

Ormenis pruinosa Say. Columbus. Common to large area in U. S. On orchard trees and various shrubs.

Ormenis septentrionalis Fab. Medina, Georgesville, Columbus, Wauseon. Common, especially southern U. S.

Amphiscepa bivittata Say. Medina, Castalia. Common. Occurs on low herbage, wider, distributed in U. S.

Helicoptera sp. (*nova* Say or near) Medina. Common.

Bruchomorpha dorsata Fitch. Wauseon. Seldom plentiful but generally distributed.

Bruchomorpha oculata Newm. Columbus. Rather rare in grassy lowland.

Otiocerus degeeri Wauseon. Not abundant. Occurs on forest trees.

Otiocerus amyotii Rocky Fork. Rather common in forest or on hickory or other trees.

Otiocerus stolli Wauseon. Fairly plentiful. Occurs from Atlantic west to Iowa at least.

Lamenia vulgaris Fitch. Wauseon. Very common in eastern U. S., west to Missouri River. Feeds on willow, thorn, beech, etc.

Stenocranus dorsalis Fitch. Columbus. Abundant in grassy lowland.

Stenocranus lautus VanD. Sandusky, Columbus, Rocky Fork, Georgesville. Common.

Stobera tricarinata Say. Common, widely distributed in U. S.

Liburnia puella VanD. Georgesville, Columbus, Rocky Fork, Sandusky. Common.

Pissonotus ater VanD. Columbus. On water willow in October. (Hine.)

CERCOPIDAE.

Lepyronia quadrangularis Say. Rocky Fork. Very common over large part of U. S. from Atlantic to Rocky Mountains, on low herbage.

Aphrophora paralella Say. Columbus (?) Common, eastern U. S. west to Ill. and Ark.

Aphrophora quadrinotata Say. Medina, Ashtabula. Common. Atlantic west to Rocky Mountains.

Clastoptera obtusa Say. Georgesville, Columbus. Abundant on willow.

Clastoptera proteus Fitch. (Loc. ?) A common species over larger part of U. S. and like preceding species represented by many varieties.

BYTHOSCOPIDAE.

Macropsis apicalis O. and B. Columbus. Hanging Rock. On honey locust. Usually very abundant where this plant occurs.

Bythoscopus distinctus VanD. Columbus, Ashtabula. Common.

Bythoscopus variabilis Fh. On *Hamamelis*. Ashtabula July 19 '99 (R. C. Osburn).

Agallia sanguinolenta Prov. Columbus. Abundant everywhere.

Agallia quadrinotata Prov. Columbus (Nymphs). A common species eastern U. S.

Agallia constricta VanD. Wooster. Usually common south.

Agallia novella Say. Columbus. Nymphs. Common eastern U. S.

Pediopsis gleditschiae O. and B. Hanging Rock. Columbus. Abundant on Honey Locust.

Pediopsis viridis Fh. Ironton. Columbus. An abundant species on willows.

Idiocerus suturalis Fitch. Wauseon.

Idiocerus snowi G. and B. Sandusky, Columbus. Common on willows.

Idiocerus alternatus Fitch. Columbus.

Idiocerus verticis Say. Columbus.

TETTIGONIDAE.

Aulacizes guttata Sign. Georgesville, Columbus. A southern species reaches its northern limit probably in central Ohio.

Tettigonia bifida Say. Medina, Castalia. Common.

Tettigonia hieroglyphica Say. Widely distributed.

Tettigonia tripunctata Fitch. Columbus, Rocky Fork, Ashtabula.

Tettigonia similis Wdw. Wooster. Common over eastern U. S., Maine to Iowa.

Diedrocephala versuta Say. Georgesville, Ironton. A common southern species. Not recorded for Columbus or farther north in the state.

Diedrocephala coccinea Forst. Columbus. Common over U. S.

Diedrocephala mollipes Say. Columbus, Georgesville, Castalia (H. O.) Wooster in matted grass (C. W. M.) Abundant everywhere in U. S. and probably ranges over most of North America. Injurious to grass.

Diedrocephala angulifera Walk. Sandusky. In coarse grasses of lowland.

Helochara communis Fitch. Columbus, Georgesville. Abundant from Atlantic to Pacific Ocean.

Gypona octolineata Say. Columbus, Georgesville. Abundant on great variety of plants.

Gypona rugosa Spang. Wauseon. Rare. Probably southern in distribution.

Gypona bimaculata Wdw. Castalia. Common in low land.

Gypona melanota Spang. Castalia. Rare. Occurs to east and west.

Gypona scarlatina Fh. Castalia. Common in low land.

Penthimia americana Fh. Sandusky, Wauseon. Common over large area in U. S.

JASSIDAE.

Acocephalus albifrous Linn. Kelley Island, Lake Erie, Castalia, Ashtabula. Usually rather rare, Maine to Indiana and Michigan.

Xestocephalus pulicarius Van D. Columbus. A plentiful little species. Atlantic to plains.

Parabolocratus viridis, Uhl. Castalia, Columbus. Common.

Platymetopius acutus, Say. Rocky Fork, Ironton, Waterloo. Common Maine to Rocky Mts.

Platymetopius frontalis Van D. Columbus, Castalia. Less common than preceding.

Deltocephalus sayi, Fitch. Columbus, Rocky Fork. Common in grassy woods.

Deltocephalus weedi Van D. Columbus, Rocky Fork. Abundant in Southern States, occurs north to central Iowa, and Ohio, in grass.

Deltocephalus nigrifons, Forbes. Columbns, Rocky Fork. Exceedingly abundant over large part of the United States.

Deltocephalus inimicus, Say. Columbus. Abundant everywhere in blue grass, etc.

Deltocephalus flavicosta, Stal. Columbus. Rather rare, occurs southward probably to southern South America.

Deltocephalus sylvestris O. & B. Columbus. In grassy timber land.

Athysanus curtisii, Fitch. Columbus, Rocky Fork. Abundant in grasses.

Eutettix lurida Van D. Rather rare.

Eutettix seminudus, Say. Columbus, Ironton. Common.

Eutettix cincta O. & B. Wooster. Rather common west to Iowa.

Eutettix strobi Fitch. Columbus. Common. Atlantic to plains. Larae occur on Chenopodium causing purple spots on leaves which they mimic in color.

Phlepsius humidus Van D. Georgesville. In low, moist places along river beds.

Phlepsius irroratus Say. Columbus. Abundant and very widely distributed in United States.

Scaphoideus immistus Say. Columbus. Common.

Scaphoideus auronitens Prov. Columbus. One specimen.

Scaphoideus scalaris Van D. Columbus one specimen.

Scaphoideus intricatus Uhl. Rare. One specimen Columbus.

Thamnotettix clitellarius Say. Columbus. Common. Often observed on orchard trees.

Thamnotettix longula G. and B. Columbus. Common.

Thamnotettix melanogaster Prov. Columbus. Abundant in lowlands, probably feeds on sedges.

Thamnotettix fitchii VanD. Columbus. Common in low land.

Limotettix striola Fall. Columbus, Georgesville. Common.

Limotettix exitiosa Uhl. Columbus. Often abundant. Sometimes destructive in fall wheat and grass land.

Chlorotettix galbunata VanD. Georgesville, Common.

Chlorotettix unicolor Fh. Ashtabula.

Chlorotettix tergatus Fh. Wooster, Ashtabula.

Jasius olitorius Say. Columbus. Common.

Gnathodus punctatus Thunbg. Columbus. Common.

Gnathodus impictus VanD. Columbus. Rather rare.

Cicadula 6-notata Fall. Columbus. Abundant.

Cicadula variata Fall. Columbus.

Cicadula punctifrons Fall. *var americana* VanD. Columbus. Sandusky. Ironton. On shrubby willow.

Alebra albostriella Fall. Columbus.

Dicraneura fieberi Mel. Columbus.

Dicraneura abnormis Columbus.

Empoasca sp.

Empoasca mali LeB. Columbus. Abundant on apple and many other plants.

Typhlocyba comes vitis Harr. Columbus. Abundant on grape everywhere.

Typhlocyba comes basilaris Say. Columbus. Common on grape.

Typhlocyba comes comes Say. Columbus. Common.

Typhlocyba comes maculata Gill. On sycamore. Columbus.

Typhlocyba vulnerata Say. Columbus. Abundant.

Typhlocyba querci Fitch. Wauseon.

Typhlocyba querci var bifasciata. Columbus. Wauseon. Common.

Typhlocyba hartii Gill. Columbus. Rare.

Typhlocyba obliqua Say. Columbus. Common.

Typhlocyba rosae Harr. Columbus, (Weed) Common.

Typhlocyba trifasciata Say. Columbus. Common.

PSYLLIDAE.

Pachypsylla celtidis-mammae Very abundant on Hackberry. Columbus, Sandusky.

Pachypsylla celetidis gemma Wooster, 10-2-'98. (C. W. M.)

APHIDIDAE.

Siphonophora circumplex. Wooster, 3-16-'97. (C. W. M.) From Easter lilies in greenhouse.

Siphonophora avenae. Wooster, O, 5-26-'98. (F. M. W.) Winged males and young in heads of rye. Givens, 6-5-'98. (S. A. Powell.) On wheat heads in great numbers.

Siphonophora rudbeckiae Fitch. Columbus. (weed.) A common species on Rudbeckia.

Aphis brassicae Linn. Common cabbage plant-louse. Everywhere common.

Aphis mali. Common apple plant-louse.

Aphis gossypii. "Cucumber plant-louse." Often very abundant and destructive. Lawrence Co., 9-28-'98. Destructive to strawberries on several premises. Bradrick 11-17-'98. On strawberry plants. (Webster.)

Myzus cerasii L. Columbus, (Weed.) On cherry Often very plentiful.

Myzus ribis L. Columbus. (Weed)

Myzus persicae. Common. "Peach Aphis."

Myzus persicae niger Sm. 8-22-'98. Waterville. Seriously abundant on roots of peach trees. (Webster.)

Lachnus strobi Fitch. Columbus, (Weed.)

Lachnus dentatus LeB. Columbus, (Weed.)

Lachnus piui L. Columbus, (Weed.)

Malanoxanthus salicti Harr. Columbus, (Weed.)

Malanoxanthus salicis Linn. Columbus, (Weed.)

Schizoneura imbricator Fitch. Common Beech blight.

Schizoneura lanigera Haussm. Common Apple root louse. Lakewood, 8-12-'96. On trunks of apple, especially injured parts. (C. W. M.) Ravenna, (F. M. W.) Wooster (C. W. M.)

Schizoneura americana Elm leaf gall-louse.

Schizoneura tesselata Fitch. Zanesville, 11-5-'96. Infesting "English Alder" (Webster.)

Pemphigus smilacinus O. and S. On smilax, Rocky Fork.

Pemphigus vagabundus Fh Vagabond gall. Columbus, Sandusky. Very plentiful at Cedar Point, summer of 1899.

Colopha ulmicola. Common Cocks comb gall on elm leaves.

Phylloxera vastatrix Planch. Grape Phylloxera. On hickory. Columbus.

ALEYRODIAE.

Aleyrodes sp. Very abundant, autumn of 1898, on Sycamore and other trees at Columbus.
Aleyrodes sp. Ada, 8-12-'96. Complained of as doing slight injury to strawberry (Webster.)

COCCIDAE.

Orthezia insignis Doug. Columbus in Greenhouse.
Orthezia americana? Georgesville. (Fullmer,)
Dactylopius citri Rossi. Mealy bug of greenhouse.
Dactylopius adonidum L. Wooster, 3-1-'98. [C. W. M.] On roots of plum and Carolina poplar in insectary. Wooster, 3-16-'98. On clover roots in incectary. [C. W. M.] Wooster, 1-19-1900. At present feeding on following plants in insectary, Canna, Barberry, Rose, Onion, Tobacco, Poplar [W. N.]
Lecanium hesperidum L. "Oleander scale."
Lecanium oleae Bern. Columbus.
Lecanium celtidis. Sandusky.
Lecanium nigrofasciatum Pergande, Cleveland, O. 12-24-'99. [F. M. W.] Thick on Norway maple.
Lecanium coffeae Walk. [Is the same as hemispherium.] Wooster, [W. N.] 1-1-1900. On *Pteris* sp. in greenhouse. Wooster, 9-7-'97. [F. M. W.] On chrysanthemum in insectary. Ashland, O. 3-10-'97.
Lecanium persicae Syracuse, 4-24-'96. Dresden 12-21-'96. (Webster.)
Lecanium armenicum Craw. Painesville, 2-5-'97. On spanish chestnut. (Webster.)
Pulvinaria acericola W. & R. Columbus.
Mytilaspis pomorum Bouche. Portage. East Cleveland. Very abundant on poplars, 7-29-'96. (C. W. M.)

Mytilaspis citricola Pack. On oranges in market.
Parlatoria pergandei Comst. Columbus.
Chionaspis furfurus Fitch. Westerville. Wooster on apple. 1-12-1900. (W. N.)
Chionaspis pinifoliae Fh. Columbus, Wooster on pines, austriaca. 1-19-1900. (Wooster.)
Chionaspis biclavis Comst. Columbus.
Chionaspis corni Cooly. Sandusky.
Diaspis cacti Comst. In greenhouse. Columbus.
Diaspis rosae Columbus. (Bogue.) Berlin Cross-roads, Jackson Co., 3-6-'97. Infesting raspberries. (Webster.) Wooster 12-7-'97, on raspberry. (C. W. M.)
Diaspis bromeliae Columbus. (Bogue.)
Diaspis amygdali Painesville. 8-16-'97. On flowering cherry received direct from Japan. (Webster.)
Aspidiotus ancylus Putnm. Columbus. Will, 5-18-'99. So abundant in spots in an Osage orange hedge as to kill the dwarfed tree. (C. W. M.)
Aspidiotus forbesi Johns. Columbus.
Aspidiotus perniciosus Comst. "San Jose Scale" Clinton Co., Catawba Id., etc, introduced. 39 localities recorded by Webster.
Aspidiotus dichrospermi Morgan. Columbus.
Aspidiotus obscurus Comst. Columbus. (Hine.) Catawba Island. 1-11-'97. (Owen.)
Aspidiotus ficus Ashm. Wooster. (Webster.) Columbus. In greenhouse.
Aspidiotus nerii L. Columbus. In greenhouse.

HETEROPTERA.

Homaemus aeneifrons Say. Ohio. Ordinarily rare.
Eurygaster alternatus Say. Ashtabula, July 19-'99, R. C. Osburn. Usually found on grasses in lowland.

CORIMELAENIDAE.

Corimelaena atra Am. et Sow. Columbus. Usually rather common.

Corimelaena lateralis Fab. Columbus. Common.
Corimelaena pulicaria.

CYDNIDAE.

Pangaeus bilineatus Say, No locality. Probably Columbus.
Canthophorus cinctus P. Beauv. Columbus. Not abundant.

PENTATOMIDAE.

Stiretrus anchorago Fab. No locality. Not common but widely distributed.
Perillus circumcinctus Stal. No locality.
Podisus cynicus Say. Georgesville. Not abundant.
Podisus spinosus Dallas. Columbus. Very common over most of U. S. Wooster. In breeding cage fed on aphis brassicae. Attacked and killed adult, *murgantia histrionica*. Adults and larvae destroying larvae of *Lina scripta*. On Carolina poplar feeding on larvae of *Ichthyura inclusa*. (Webster.)
Brochymena arborea Say. No locality. Common to eastern U. S. generally.
Brochymena annulata Fab. Columbus. Common U. S. generally. Gypsum hibernating in grape leaves. (Webster.)
Neottiglossa undata Say. Columbus, Georgesville, Castalia.
Cosmopepla carnifex Fab. Columbus. Ashtabula July 19-'99. (R. C. Osburn.)
Mormidea lugens Oliv. "Ohio." Said to occur on mullein.
Euschistus fissilis Uhl. No locality, probably Columbus.
Euschistus tristigmus Say. Georgesville, Columbus.
Euschistus variolarius P. Beauv. Columbus, Castalia (H. O.,) Ashtabula. (R. C. Osburn.)
Fidelity. (Webster.) Larvae observed de-

stroying larvae of unicorn prominent. (Webster.)

Hymenarcys aequalis Say. Columbus, Georgesville.

Hymenarcis nervosus Say. Castalia.

Menecles insertus Say. Georgesville. Usually rare.

Trichopepta semivittata Say. Ashtabula July 19-'99. (R. C. Osburn.)

Peribalus limbolarius Stal. Georgesville, Columbus. Abundant in autumn on Golden Rod and other compositae.

Thyanta custator Fab. Columbus. Abundant especially westward.

Murgantia histrionica Hahn. Cincinnati, Columbus, Wooster. Southern, has extended distribution northward but seems to have reached its limit.

Nezara hilaris Say. Columbus, Common over wide area.

Nezara pennsylvanica Fab. One specimen. Columbus. Rare.

Banasa calva Say. Columbus. Not common. Occurs west to Rocky Mts.

COREIDAE.

Chariesterus antennator Fab. Columbus.

Corynocoris distinctus Dall, Ashtabula, July 19-'99. (R. C. Osburn.)

Archimerus calcarator Fab. Three specimens. No locality. Probably Columbus. Common to United States generally.

Euthoctha galeator Fab. Wauseon. Common over U. S.

Metapodius terminalis Dall. Georgesville.

Leptoglossus oppositus Say. Columbus. (Snyder.)

Anasa trstis D. G. Columbus, Wooster. The common "Squash bug."

Alydus conspersus Mont. Columbus, Castalia.

Alydus eurinus Say. Columbus, Castalia.

Alydus pluto Uhl. (?) Rocky Fork. Described from

Colorado but occurs in Dakota and Iowa, no record further east.

Protenor belfragei Stal. Columbus, Sandusky. Frequents low land on rank grasses.

Harmostes reflexulus Say. Columbus. Common. Widely distributed in U. S. and Mexico.

Corizus lateralis Say. Wooster. Found among stems of Malva rotundifolia. (Webster. (C. W. M.)

Corizus nigristernum. Sign. Common U. S. generally.

Corizus novaeboracensis Sign.

Neides muticus Say. Sandusky, Medina.

Jalysus spinosus Say. Columbus.

LYGAEIDAE.

Nysius thymi Wolff.

Nysius angustatus Uhl. Wauseon. Reported in strawberries as "eating them to the ground."

Blissus leucopterus Columbus, Sandusky, etc. "Chinch bug."

Cymodema tabida Columbus.

Geocoris sp. Columbus.

Oedancala dorsalis Say. Hanging rock, Ironton.

Myodocha serripes Oliv. Columbus. More common southward. Flushing 6-15-'98. Abundant in a strawberry bed. (C. W. M.) Radnor, complained of as injuring strawberries.

Heraeus plebejus Stal. [?]

Pamera bilobata Say. Sandusky. Rare.

Pamera basalis. Dall. Columbus, Georgesville.

Eremocoris ferus Say. Akron.

Trapezonotus nebulosus Fall, Columbus. [C. W. M.]

Peliopelta abbreviata Uhl. Columbus, Wooster. In matted grass. Gypsum, hibenating in grape leaves. A common species east of plains.

Lygaeus turcicus Fab. "Ohio." Castalia, Sandusky. Common on Cedar Point on asclepias.

Oncopeltus fasciatus Dallas. Columbus.

CAPSIDAE.

Miris affinis Reut. Columbus.

Leptoterna dolobrata Linn. Wooster. Very abundant.
Collaria oculata Reut. Ashtabula.
Collaria meilleurii Prov. Ashtabula.
Teratocoris discolor Uh. Wooster.
Calocoris rapidus Say. Columbus, Castalia.
Melinna fasciata Uhl. Wauseon.
Melinna modesta Uhl. Sandusky.
Lopidea media Say. Hanging Rock.
Lygus pratensis L. Sandusky, Columbus, Castalia. Common to Europe and America. Varying from temperate and tropical regions. Lowelville, abundant on leaves of celery. (Webster.)
Poecilocapsus lineatus Fab. Columbus. Granville.
Poecilocapsus goniphorus Say. One specimen. No locality. Probably Columbus.
Hyaliodes vitripennis Say. Wauseon.
Pilophorus bifasciatus Fab. Wauseon.
Halticus uhleri Giard. Stone-lick, 5-16-'99. (C. W. M.) Wooster.
Halticus bractatus Say. Lawrence Co., 9-28-'98. On strawberry in limited numbers. (Webster.) Wooster, Lakewood. Abundant on cucumbers in greenhouse. Wooster 1-1-'97 on rose in insectary. (C. W. M.)
Garganus fusiformis Say. Columbus, Rocky Fork.
Xenetus scutellatus Uhl. One specimen, Columbus, May 30-'99. Hanging Rock.

ACANTHIIDAE.

Triphleps insidiosus Say. Columbus.
Acanthia lectularia L. Columbus and elsewhere.

TINGITIDAE.

Piesma cinerea Say. Columbus. Common, has variety of food plants and ranges over an extended area.
Corythuca arcuata Say. Columbus. Common on Oak, Hawthorn, etc.

Corythuca ciliata, Say. Columbus. Abundant on Sycamore.

Gargaphia tasciata Columbus. Common on Linden.

ARADIDAE.

Aradus robustus Uhl. Columbus.

Neuroctenus simplex Uhler. Columbus. Abundant under bark of fallen trees.

PHYMATIDAE.

Phymata fasciata Gray. Columbus. Abundant. Ranges far to south and west.

NABIDAE.

Coriscus subcoleoptratus Kby. Wauseon.

Coriscus ferus Linn. Columbus, Wauseon, (Hine.) Wooster 3-30-'97. On corn growing in Insectary 10-26-'96. Feeding on plant lice in winter wheat. (C. W. M.)

Coriscus punctipes Reut. Columbus.

REDUVIIDAE.

Sinea diadema Fab. Columbus.

Acholla multispinosa DeGeer. Sandusky, Wauseon.

Milyas cinctus Fab. Columbus, observed clustering on trees in autumn of '98. Wooster 9-22-'99 (C. W. M.)

Diplodus luridus Stal. Gambier. More common southward.

Melanolestes picipes H. Schf. Georgesville. Common. Extends west to Ia. and plains. "Kissing bug."

Opsicoetus personatus L. Loc. (?)

Conorhinus sanguisugus Lec. Cincinnati, (Dury.) Common in southern states. This would seem to be about its northern limit.

Pnirontis infirma Stal. Columbus. A southern species. Rare in this latitude.

Pygolampis pectoralis Say. One specimen. No locality. Columbus [?] Fairly common in this latitude farther west.

Oncerotrachelus acuminatus Say. Columbus. Common. A southern species. This is probably about its northern limit.

Emesa longipes De G. Columbus. Put in Bay. Common. Occurs on various trees. Carnivorous remarkable for very slender body and legs.

LIMNOBATIDAE.

Limnobates lineata Say. Columbus. Widely distributed.

HYGROTRECHIDAE.

Hygrotrechus remigis Say. Columbus. Water strider. Abundant over large part of U. S.

Limnotrechus marginatus Say. Columbus. Common and widely distributed.

VELIIDAE.

Stephania picta H. Schf. Columbus. Common on quiet water.

Rheumatobates rileyi U. Columbus. This very interesting little species I found quite plentiful at Big Run south of Columbus.

Hebrus americanus Uhl. Columbus. A minute species of wide range.

Rhagovelia obesa Uhl. Columbus.

SALDIDAE.

Salda ligata Say. Wauseon.

Salda interstitialis Say. Wauseon, Sandusky.

Salda humilis Say. Columbus, Sandusky, Johnsons, Id. Abundant.

Salda orbiculata Uhl. Ironton, June, 1899. Wooster.

GALGULIDAE

Galgulus oculatus Fab. Sugar grove (Kellicott) a southern species.

BELOSTOMATIDAE.

Zaitha fluminea Say. Columbus. Abundant over eastern U. S.

Belostoma americana Leidy. Columbus. Abundant and widely distributed.

Benacus griseus Say. Columbus. Abundant and widely distributed.

NEPIDAE.

Nepa apiculta Uhl. Columbus.

Ranatra fusca Pal Beauv. Columbus.

Ranatra 4–dentata Stal. Columbus. Our most common form, ranges south and west.

NOTONECTIDAE.

Notonecta undulata Say. Wauseon. Abundant over large part of U. S. Columbus. Common.

Notonecta irrorata Uhl, Columbus.

Plea striola Fieb. Columbus. Abundant and widely distributed in U. S.

CORISIDAE.

Corisa alternata Say. Columbus. Very abundant and of wide range.

Corisa harrisii Uhl. "Ohio." Common. Widely distributed.

PLANT PHOTOGRAPHY.

BY CARL KREBS, CLEVELAND, OHIO.

Since the improved and simplified methods of photography have facilitated its use, it has become a valuable adjunct to scientific research.

In botany, this art has not been applied very extensively as yet. The reason for this may be, perhaps because few botanists are enough versed in operating a camera to overcome the difficulties, which plant-photography presents, whereas; artists do not seem to possess the appreciation and knowledge neeessary to produce pictures of botanical subjects.

Occasionally we meet with plant illustrations obtained from photographs in writings of travel and exploration, but they are usually small and crude, and consequently of no scientific value.

A most beautiful collection of plant photographs is in possession of the museum of Kew in England, among which might be mentioned a group composed of Venus fly-trap, pitcher plant and sun dew: another one of different lichens on a piece of rock: one showing methods of seed dissemination; and still another one, a Rafflesia taken with the wild surroundings of its tropical home.

From experiences gained in obtaining my own collection of plant photos, I will quote the following fundamental points to be observed.

Groupes of plants, shrubs, trees and vegetation pictures are of course taken in their native haunts.

Large individuals may be taken in the same way, providing the surroundings contrast enough with the different parts of the plant, so as to show up well in the picture.

Plant pictures should have artistic effects, but not at the cost of definition and detail, for they must show the searching eye of the botanist the very pubescense on stem and leaves. In order to obtain such definition, the smallest diaphragm or opening of the lens is used, which then requires a time exposure to sufficiently effect the sensitized plate.

In out-door work, therefor, it is necessary that the atmosphere should be perfectly calm, for the least motion of the plant will blurr the picture. As a perfectly calm day however is a rare thing, a chance exposure, made during the temporary lull of the wind, will usually succeed.

Small plants and parts of plants are best taken to the operators studio or a convenient place, where thev can be posed in front of a white, black or shaded screen as the case may require. Care must be taken to allow enough space between subject and screen to avoid the casting of shadows on the latter.

Photographing a plant in a comparatively large size, necessitates a close focus, allowing but a small depth of perspective. In this case bushy plants, twigs and branches present a great difficulty, for these parts must be brought as much as possible into a plane parallel to the lens, in order to prevent them from appearing out of focus.

A soft diffused light is almost imperative for taking plant pictures in order to avoid deep shadows, which efface detail.

The various tints of the vegetable kingdom offer many problems to photography, as different colors affect the ordinary sensitized plate with different

degrees of actinity. Thus green and red acts very slow, whereas blue acts quickly. Isochromatic plates and ray filters correct these effects.

As to the development of the exposed plate the ordinary processes for bringing out detail are used. Dark and under-exposed parts of a negative may be urged along by taking the plate out of the bath at intervals and breathing upon the parts in question.

Finally to make the prints, the platuium papers have proved most satisfactorily, giving both definition and artistic effects. Then also the different tones of brown, yellow, black and olive possible to attain with these papers, when appropiately applied do much to enhance the beauty of the pictures.

Since time and space will only permit of referring to a few of the chief points to be observed, this paper must be limited to the afore-said.

Although it can hardly be assumed that plant photography would be practical for illustrating elementary botanies, it is beside being a fascinating study in itself an interesting and attractive way of recording many botanical observations.

Ohio State Academy of Science.

SPECIAL PAPERS No. 3.

THE PREGLACIAL DRAINAGE OF OHIO

Comprising the Results of Researches made by Members of the Academy of Science, by the aid of the McMillin Research Fund.

PUBLISHED BY THE ACADEMY OF SCIENCE
WITH THE EMERSON E. McMILLIN RESEARCH FUND.

December, 1900.

PRESS OF FRED. J. HEER, COLUMBUS, OHIO.

PREFACE.

AT the 1898 winter meeting of the Ohio State Academy of Science, Mr. Emerson E. McMillin, already a life member, through Professor W. R. Lazenby, tendered the Academy the sum of $250.00 to be expended by the trustees in furthering original scientific researches in Ohio. The donor placed no restrictions upon the use of this fund except to express a desire that, so far as possible, it be used in aiding those who are competent and willing to give their time, but unable to contribute their expenses while employed in their researches; thus giving aid to such independent workers as lacked the necessary financial resources. Among the grants made by the trustees during 1899, from this fund, were $50.00 each to Professors Tight and Bownocker, and $10.00 to J. H. Todd, M. D., for the purpose of aiding them in studying the Preglacial Drainage of certain portions of Ohio. From this fund for 1900, Mr. Gerard Fowke was granted the sum of $25.00, for a similar purpose. The results from the work prosecuted under these grants are herewith transmitted as No. 3 of the Series of Special Papers. Mr. Fowke has kindly consented to prepare an introduction, giving a short review of work previously done along this line of research in Ohio. The map facing preface illustrating the preglacial drainage of the entire State, so far as it has been worked out, has been prepared by Professor Tight.

The expense of publication has also been taken from Mr. McMillin's research fund, which he has been kind enough to continue for 1900.

Professor Raymond Osburn was granted $50.00 in 1899 to aid in the study of the fishes of the State, and a similar sum was granted him in 1900. The results of Professor Osburn's researches are being prepared for publication and will constitute No. 4, of this series, and will be issued early in 1901.

F. M. WEBSTER, *Chairman*,
H. C. BEARDSLEE,
JOHN H. SCHAFFNER,
Trustees Ohio State Academy of Science.

INTRODUCTION.

FOR many years the abandoned water courses in Ohio have perplexed geologists. Most of them are attributed to streams in the immediate vicinity. Some, however, are in such situation that no existing river or creek could produce them unless very great alterations of level should take place. Others interlock in a manner which would require exceedingly rapid and violent changes in any stream now found within many miles, if their origin is to be thus explained. For example, each one of four ancient valleys located within the limits of Hamilton county, namely, back of Cincinnati, along Mill creek, at North Bend, and across the northern and western ends of the county, is accounted for by assuming that "the Miami river must have once followed this course." But it would be impossible for the Miami to excavate them, because all have a greater depth than the bed of the Ohio river; and the latter could never have been deeper than it is now, for below the mouth of Mill creek there is rock bottom. Besides, the Miami could form them only by accomplishing the improbable feat of eroding a deep channel and then, without any discoverable reason, deserting this course and carving a new one for itself through the bordering hills.

The same difficulty is encountered when the attempt is made to connect former and recent stream beds in various other parts of the State.

The great variation in width of different portions of the Ohio valley has also awaited explanation. A traveler from Pittsburg to Evansville will find the hills on either side alternately approaching the water and receding from it. In some parts they are so steep and come so near together, as to form a veritable gorge; again, level or terraced bottom lands a mile or even more in width intervene between the shores and the high lands. Moreover, there is no system or regularity about these changes. Sometimes there may be observed a gradual increase in width,

very slight it is true but still perceptible, the hills presenting gentle slopes and smooth, rounded outlines; then the valley begins to narrow, the hills are more sharply outlined, and presently the stream is running between precipitous walls. At intervals the valley will expand to a width much greater than is to be found for many miles above or below; and after holding a practically uniform width for some distance will rapidly contract.

Modifications of this character are usually asserted to be due to the diversified composition of strata through which the river makes its way. To the same cause, too, are assigned the frequent abrupt curves, some of them so sharp that the river seems almost to double back on itself. There are, to be sure, many degrees of hardness and of solubility in all the rocks through which the Ohio has cut its channel; and these properties would certainly be factors in the phenomena observed. But, even where these features are most pronounced, the rock seems to be tolerably homogeneous in its structure; and it does not seem reasonable to suppose that inequalities of this nature would be so capriciously distributed as would have to be the case were they the only or even the principal cause of such conditions.

In recent years much thought has been given to these questions, and some investigations conducted mainly by Prof. Tight as shown by his article have given us the key to the problem. It is very easily answered; being simply the fact that prior to the glacial period the Ohio as a separate stream had no existence. Its present channel was occupied by a series of disconnected water courses, varying in size from small ravines to large rivers. The expansions in its course are the valleys of the larger pre-glacial streams; the abrupt curves and numerous windings result from the efforts of the stream to find the lowest level in broken and irregularly eroded country across which it must seek a path from one valley to another; and the narrows or gorges mark the places where it broke through the minor watersheds that obstructed its progress.

The following pages contain the result of examinations made within the past two years, under the auspices of the Ohio Academy of Science. There are some references in the text that

will inform the reader who wishes to pursue the subject further, where to obtain additional information.

Professor Tight whose previous researches have been largely carried out in the Muskingum and Hocking valleys has extended his work down the present Ohio valley as far as Manchester, in Adams county, where he locates a col which marked the line of division between the waters flowing east in the present bed of the Ohio and those flowing west. As some statements in the present paper can not be understood by those who are not aware of his discoveries in this region, it may be well to say that he has demonstrated that Kanawha river in preglacial times flowed westward from St. Albans, past Guyandotte, to the Scioto, and followed that valley northward. Into this river flowed all the creeks and rivulets rising east of the Manchester col. Beyond Circleville it has not been traced, as the old valley is obliterated by the drift deposits of the ice-sheet. Some data are at hand, however, as mentioned in Professor Bownocker's paper, indicating that it pursued a westerly course and left the State somewhere about the Celina reservoir.

The history of the Little Miami, as worked out by Professor Bownocker, is important in that it shows the general tendency of the drainage of southern Ohio toward the north and west. This would not be the case unless there was an outlet for the waters in that direction, such as old Kanawha seems to have furnished.

The chief value of Doctor Todd's article is to be found in the evidence which it presents that vast changes following the advent of the ice-sheet were by no means confined to the immediate region of the Muskingum and the Ohio, but reached to the borders of the Lakes, thus showing a probable northern outlet for the waters in that direction also.

The concluding paper treats of the Ohio river from the point where Professor Tight leaves it. The old waterways in this section being more plainly marked and less complicated than they are further east, the labor of deciphering has been less difficult.

A great field is opened up for those who are to continue these researches. There is probably not a stream in the State,

ancient or modern, which has not been more or less modified by the influences described, even to the extent, in many cases, of owing its origin to them. The work will be incomplete so long as any portion of the State remains uncharted. And it must extend still further before a complete history of the Ohio river can be written. As yet, we know nothing of the preglacial conditions below Louisville, or of the tributary streams in southern Indiana and western Kentucky.

It may not be out of place to call attention here to a matter which seems to have escaped notice heretofore.

The oldest land in Ohio is that along the Cincinnati axis, in the western part of the State. From here, through three geological eras, the Upper Silurian, Devonian, and Sub-Carboniferous, the slope was toward the southeast; consequently the surface flow must have been in the same general direction. It is quite possible that to this epoch are to be assigned the older erosion planes mentioned by Professor Tight in his present paper. Not only in Ohio, but in the neighboring States as well, are to be observed these old levels at an average elevation of about two hundred feet above the present streams. The suggestion is ventured that these represent drainage lines as they existed prior to the Appalachian uplift. Such valleys must have formed in the immense length of time during which surface waters sought the constantly receding ocean that bordered the swamps of the coal measure period. When these were uplifted into mountain ranges, the elevation must have been general enough to produce a considerable effect upon the region to the westward. Otherwise a trough would have resulted between the land just emerging from the sea and that which had so long stood above the waves. Had this been the case, it would seem that the ancient rivers must have turned toward either the north or the south, and flowed around the island on which they had their birth. Instead of this, however, we find the entire drainage of the newly risen country flowing back directly across the formations whose waste had assisted in building it up. It is a plausible supposition that the high level valleys pertain to a pre-Carboniferous drainage toward the southeast; while some at least, of the narrow and deep valleys cut through

or along them are features of a reversed drainage, of pre-glacial age, toward the northwest; and that it is the latter which has been again reversed and sent off to the southwest by the continental ice-sheet.

A serious objection, and one which may be fatal to this suggestion, is the great length of time that has elapsed since the Apalachians were formed. This is sufficient for subsequent erosion to have effaced all inequalities of level which prevailed in the central valleys at that period. However, minor oscillitations may have occurred which would preserve or perpetuate the older valleys.

At any rate, whether any evidence now remains of it or not, there must have been a former drainage from western Ohio toward the eastward; and this drainage must have become reversed when the Allegheny plateau was raised to a sufficient elevation. The only escape from such conclusion is in assuming that all the teachings of our geologists, previous to this time, concerning the succession of formations, are erroneous. While very many errors, due to lack of data, have crept into our text-books, the sequence of geological deposits in this region seems well established. If not so early as herein intimated, these high-level valleys may still belong to a drainage period antedating either of those discussed in these papers.

GERARD FOWKE.

DRAINAGE MODIFICATIONS IN WASHINGTON AND ADJACENT COUNTIES.

BY G. W. TIGHT.

INTRODUCTION.

The study of the region treated of in this paper was undertaken as the natural out growth of the work previously done in the surrounding sections. The correlations of the preglacial drainage in the areas to the east, north and west left this region of the lower Muskingum somewhat isolated and very naturally raised the question as to its preglacial conditions of drainage. On account of the position which the region occupies, the restoration of the old drainage has a very important bearing on the interpretations already worked out for the surrounding regions. The problem is one which was recognized by Prof. E. B. Andrews and referred to in the second volume of the Ohio Survey, where he says: "The drainage features of the county (Washington) present some very interesting facts. The Ohio River, Little Muskingum, Duck Creek ,and the Muskingum all converge towards a common center, the last three uniting with the former in Marietta township." "The slopes of nearly half a circle find their lowest point at a common center in Marietta township." And after a brief description of the stream courses he further states: "Thus it will be seen that the county presents a great variety of surface slopes. In the eastern half of the county the slope is southwestern and southern, while in the western, i. e., west of the Muskingum, it is chiefly northern and southwestern. While the general drainage of southeastern Ohio is to the southeast, the large streams, like the Muskingum and Hocking, flowing in a direction approximately at right angles to the direction of the Ohio, yet in Washington county we have almost every variety of direction." "What originally determined the flow of streams in these different directions it is impossible now to determine. In some parts of the state the dip of the strata determines the direction of drainage, but this can not be the case to any large extent in Washington county." And

again: "It is true that the direction of streams is, for limited distances, determined by the character of the strata of rocks in which they flow, the softer rocks yielding a passage while the harder resist. This will explain many of the crooked ways of our streams which would be otherwise utterly inexplicable. But this cause could not have determined the general direction of the streams in Washington county."

In Dr. S. P. Hildreth's Geological Report for 1838 he states, after a brief description of the old valley floors in this region: "From the frequency of these flat lands between the headwaters of the Little Hocking and the south branch of Wolf Creek, it is quite possible that at some remote period the waters of Wolf Creek were discharged into the Ohio instead of the Muskingum." "Great changes, evidently, have been made in the direction of all our water courses before they found their present levels."

While it is apparent that the earlier geologists partially recognized the problems presented by the typographic features of the region and made some observations and deductions there seems to have been no systematic endeavor to follow up the study.

As considerable field work, scattered through several years, had already been done in the region by the author, it was with pleasure that he suggested to the trustees of the Ohio State Academy of Science, upon their request for information concerning the problems in the field of geographic geology of the state, that this region be further studied, with a view to the more complete correlation of the data in hand and the publication of a report of the same. By the action of the trustees a grant was made to the author which enabled him to spend five weeks in field study. This grant was from the Hon. Emerson E. McMillin Special Research Fund of the Ohio State Academy of Science.

The field studies conducted under this grant in connection with the work previously done have enabled the author to make what he believes to be a correct solution of the problem of the preglacial drainage of the region.

While the conclusions reached, as a result of this work, seem to be thoroughly established, still the work can be con-

sidered as only fairly begun and this report is scarcely more than a preliminary statement which it is hoped will give a general view of the field and serve as a stimulus to more thorough and detailed work. Many interesting and important questions remain still to be answered by more extended field study. Some of these are indicated on the accompanying map. It is not expected but that, here and there, minor modifications of the results presented may arise from this more careful and detailed field study, but the main features of the preglacial drainage seem to be so thoroughly established as to leave little room for doubt in regard to the correctness of the general correlations. The matter will be presented very largely in the order in which it was worked out in the field studies. Some references will be made to earlier work and observations, but it is not intended that this shall be in any sense a completed monograph of the region. Most of the facts presented in the text find their expression in the accompanying map (Plate I) and illustrations in a form which will give to those not familiar with the region a clearer idea of the results. Much of the detailed data is purposely omitted from this paper and only such are given as bear directly on the general conclusions.

The author desires to take this opportunity to express his thanks to the generous donor of the Special Research Fund for this practical interest in pure science, and in the Ohio State Academy of Science, and to the trustees of the fund for their confidence in his ability to wisely expend the portion allotted to him. And furthermore, to express the hope that the results herein presented will prove of sufficient value to warrant this generosity and confidence.

LOCATION OF THE AREA.

The region under consideration embraces all of Washington county and parts of all the counties which bound it in both Ohio and West Virginia. It includes the territory drained by the section of the Ohio from New Martinsville, W. Va., to the mouth of Shade River, Ohio, except that portion of the Muskingum above the north line of Morgan county, and of the Hocking above Athens, in Athens county. The section lying north of the

Ohio River and west of the Muskingum River has received most attention, as within this area the most important changes of drainage have taken place. Only a limited amount of time has been given to the section east of the Muskingum, in the Duck Creek and Little Muskingum basins, so that scarcely more than a few suggestions are offered concerning the modifications which have there taken place. The entire area considered lies far outside the glacial boundary of Professor G. F. Wright and the only deposits of glacial material are the gravel trains along the Ohio, Muskingum and Hocking and a few scattered erratics which occur at various elevations on the inter-fluvial tracts.

RELATION TO ADJACENT DRAINAGE.

Immediately to the north of this region is a large area now drained by the Muskingum. The preglacial drainage of this northern part of the Muskingum River has already been traced with considerable detail and the results published in the Bulletins of the Scientific Laboratories of Denison University, Volume VIII, Part 2, page 35; Volume IX, Part 2, page 33, and Volume XI, Article VIII. In these reports it is shown that the preglacial drainage consisted of a main stream which had its head in the upper waters of the Tuscarawas and flowed southeasterly past Dresden, Newark and into the present Scioto basin near Lockbourne, south of Columbus.

Into this main valley emptied many tributaries. Only three of these are of especial concern in this connection. They are, first, the Wills Creek valley which h[illegible] directly north of the Duck Creek basin and extends northw[illegible] into the Tuscarawas above Dresden. This valley has not as yet been studied and it may be that the present valley is composed of several preglacial elements. Wills Creek has a very crooked course and as far as the data in hand now show, is an aggrading stream. It presents many interesting features well worthy of more careful study. Secondly, just west of the Wills Creek basin is the portion of the Muskingum River from the north Morgan county line to Dresden. It is shown in the works already referred to that this section of the Muskingum is reversed and that in preglacial times there was a col on the Muskingum at


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the north Morgan county line and from this col there was a small tributary ran northward into the main preglacial axis.

The third section is that of the Jonathan Creek which was tributary to this reversed Muskingum section at Zanesville. The headwaters of these northward flowing streams are shown on the accompanying map (Plate I).

To the east of the region lies the drainage basin of the Monongahela and upper Ohio. The modifications in this section have been very great and have been the object of study by many geologists. A summary of the work done by the earlier students, with newly added data, is given by Dr. T. C. Chamberlin and Mr. Frank Leverett in the American Journal of Science, Volume XLVII, No. 280. According to these authors there was an old col on the Ohio a little below New Martinsville, W. Va. Fishing Creek being the headwaters of the stream which flowed northward up the present Ohio's course above New Martinsville into the then northward discharging Monongahela. The region to the west and southwest remains open to further investigation.

CHARACTER OF THE BOUNDING WATERSHED.

The watershed which surrounds the region is a well marked topographic feature and quite regular in its general outlines. It rises to a nearly uniform elevation, being somewhat higher to the southeast and lower to the northwest. To the southeast it forms the divide between the tributaries of the Ohio and the Monongahela. It forms everywhere a high dividing ridge, except at the several points where it is cut through by the present drainage lines. Here the streams have narrow, gorge-like valleys and the elevation of the ridge persists surprisingly near to the stream courses. While the cols crossed by the streams must have been low they were evidently quite narrow gaps or else the ridge would show more of a lowering at these points. Only a small portion of the divide is shown on the map and this is cut in but two places, i. e., at the north Morgan county line and below New Martinsville.

DISTRIBUTION OF THE PRESENT DRAINAGE.

The distribution of the present drainage is shown on the map (Plate I) in black. The Ohio is the major stream and this crosses the region in a general southwesterly direction. The next larger stream is the Muskingum which enters the Ohio on the northern side at Marietta. Next in importance is the Hocking which enters also on the northern side of the Ohio and has a general southeastern direction, rather abnormal to the course of the Ohio.

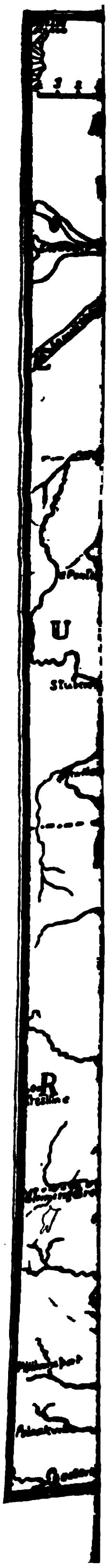
On the southern side of the Ohio the Little Kanawha enters at Parkersburg. East of the Little Kanawha lies the considerable basin of Middle Island Creek, which enters the Ohio just above St. Mary's. To the west and southwest of the Little Kanawha is the basin of the Big Kanawha. The modifications which have taken place on the Big Kanawha are discussed by the author and by Mr. Frank Leverett in the Denison University Bulletin, Volume IX, Part 2, Articles III and IV.

On the northern side of the Ohio and east of the Muskingum are the valleys of the Little Muskingum and Duck Creek, both tributary to the Ohio a little above the mouth of the Muskingum. West of the Muskingum and between it and the Hocking is the somewhat branched system of the Little Hocking. This has two main branches, the North Branch and the East Branch.

East of the North Branch of the Little Hocking and north of the Big Hocking is the basin of Federal Creek. This is a very peculiar stream as it flows in almost a circular course with many radial tributaries, those on the north side of the circle being much longer than those on the south side.

South of the lower portion of the Hocking is the Shade River system with its three main branches, East, Middle and West Forks.

The only other considerable stream in the region is Wolf Creek. This rises in northern Morgan county and flows southward and eastward and enters the Muskingum at Beverly. A short distance above its mouth it receives a tributary of consid-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erable size, South Fork. This tributary parallels the Muskingum for many miles but flows in the opposite direction.

It is seen that the present drainage is very much diversified and abnormal.

GENERAL TOPOGRAPHIC FEATURES.

The topographic features of the region are quite as varied as its drainage distribution. The present forms, being the resultant of at least two cycles of erosion, which in many ways were quite discordant, show every variety of combination of parts of each cycle. A few miles northwest of Marietta there is a group of very high points in the ridge which separates the headwaters of the East Fork of the Little Hocking and the South Fork of Wolf Creek, from the waters of the Muskingum and Ohio.

This ridge is the northward continuation of the high ridge in West Virginia which separates the waters of Middle Island Creek from those of the Little Kanawha. On a very high portion of this ridge and several miles north of Marietta is located a large Catholic Church which has a tall spire tipped with a gilded cross. This church serves as a convenient land mark for a radius of from twenty to thirty miles. A little south of the church on this same ridge is a high hill, marked on the map (Plate I) Horizon Hill, for from its summit there is an unobstructed view in every direction for many miles. From this elevated point of view the general surface of the region is seen to rise to the north, east and south and to sink to the west, in the direction of down the Ohio and the East Fork of the Little Hocking. With this general surface configuration all the larger streams are in general accord and suggest at once that their direction was largely determined by the slope of the general surface of the upland plain. From this high elevation the deep, narrow valleys that traverse the region are lost in perspective and a very fair picture is obtained of the old features as they existed before the work of the deeper erosion was accomplished. This old land surface was a gently rolling plain. The valleys were very broad Vs in cross section and the ridges and hills were low. The entire relief of the region ranged between 150-200

feet. The old slopes were well graded and the angles of slopes very low. It would have been considered very fair agricultural lands. A photograph taken from our standpoint gives a good idea of the features of this old form. The surface is seen now dotted with farm houses and the cultivated lands of the region are principally located on this old surface.

On closer inspection it is observed that this rolling surface is very deeply scarred by an extensive net work of narrow, deep valleys which are present almost every where over the region; the principal exception being along the present divide separating the waters of Wolf Creek from those of the Little Hocking. The reasons for this notable exception will appear later. In many places these deep valleys are scarcely more than narrow gorges. They vary in depth below the old surface from 100 to 250 feet, depending upon their proximity to the larger streams. Their slopes are so steep that they are rarely cultivated but are usually covered with timber. They are such a barrier to the construction of roads that over large areas there are two almost distinct systems of highways, one the valley roads and the other the ridge roads. These often parallel each other for many miles without connection. The valley roads pass over the ridges at the head water gaps where they are usually crossed by the ridge roads. There is everywhere a well marked change in the angle of the slopes between the old surface and the deeper valleys, indicating very clearly the line between the old erosion cycle and the more recent. So that the fact that the region has experienced a very wide spread rejuvenescence is very apparent.

The exceptions to these general features are rather local and require a more detailed treatment. They are the flat low lands associated with the present divides and the broad valleys of the larger streams.

CHARACTERS OF THE OHIO VALLEY.

The Ohio River valley where it enters the region in the vicinity of New Martinsville, is a very narrow gorge.

The bordering hills are very steep, often exposing vertical cliffs which rise to the level of the adjacent table land. The river

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1. View on the Ohio, looking up the 16-mile stretch at Long Reach.
2. Near view of Second Hill on Left Bank in 1. New Slope to the River. Old Slope away from the River.
3. View looking north across the Little Muskingum Basin. Characteristics of bird's eye views of South Eastern Ohio,

can scarcely be said to have a valley in the general usage of the term, for it is hardly more than a passage way through a rough and hilly country. The bottoms along the sides of the stream are very narrow or entirely wanting and the high water stages of the river wash the talus slopes on both sides of the river. Figures 1 and 2 of plate II show some of the features of this part of the valley.

Passing down the river towards Marietta, the valley becomes gradually wider and the bordering hills less high and abrupt. This is more noticeable where the larger streams enter the Ohio. There is a sharp bend in the valley at the mouth of Bull Creek where the river turns north towards Marietta and again at the mouth of the Muskingum at Marietta where the valley turns again towards the southwest. A little below Marietta there is a very considerable narrowing of the valley. This is so apparent that it is quite suggestive that possibly this might be the location of an old col in the ridge that separates the Middle Island creek and Little Kanawha basins and which appears so strongly developed on the north side of the Ohio between the head waters of east fork of little Hocking and the Muskingum.

A little below Marietta the valley turns to the south as far as the mouth of the Little Kanawha at Parkersburg. Throughout this portion the valley is quite broad but still the valley walls are quite steep and precipitous. In making the great bend at Parkersburg the river has cut back the hills on the West Virginia side so that the valley has extensive bottoms on the Ohio side. The valley width remains about constant from Parkersburg to the mouth of the Little Hocking but it narrows very rapidly from that point to the col marked on the map above the mouth of the Big Hocking. At this col the valley is only about three quarters of a mile wide and vertical cliffs form the valley walls. Below this col the valley broadens again gradually towards the southwest.

CHARACTERS OF THE MUSKINGUM VALLEY.

The Muskingum River crosses the north Morgan county line in a very narrow gorge-like valley. The bordering hills present very steep, often vertical faces to the river and rise from 250 to 350 feet above it.

Passing southward the valley gradually broadens through Morgan county and reaches its maximum width, in this section, near Roxbury where it bends sharply to the north and becomes rapidly narrower and its walls more precipitous until at the col near the sharp bend to the south (Figure 2, plate III,) the valley is a narraw gorge. After passing the mouth of Meigs Creek the valley broadens again to the mouth of Wolf Creek, at Beverly, from which point it begins to narrow again on passing further down the stream, until it reaches a minimum at the point marked col on the map, a short distance above Lowell (Figure 1, plate III). From Lowell onward to its mouth it increases in size and width until at Marietta the valley is as large as that of the Ohio itself.

Throughout the course of the valley there are extensive gravel terraces in the broad and open portions but these are entirely absent in the narrow section above Meigs creek and but very slightly show in the Lowell narrows. These terraces are the gravel trains which head far up the Tuscarawas and Licking in the morainic belts of the glaciated area.

CHARATCERS OF THE LITTLE MUSKINGUM AND DUCK CREEK VALLEYS.

These valleys have not been studied as carefully as the others and only their very general features are referred to. The vallay of the Little Muskingum is rather narrow throughout its entire length. It shows a marked tendency to broaden out at the points where it receives its largest tributaries. It is cut out of the floor of a broad basin-like valley of the old land surface. One of its remarkable features is its close parallelism to the Ohio through its entire length. A view from the divide which separates the Little Muskingum from the Ohio, (Figure 3, plate II), shows at a glance that the old valley of the Little Muskingum was very much larger and had reached a more advanced stage of planation than that of the stream which was later occupied by the Ohio. A view looking northward from this divide across the Little Muskingum country is in very striking contrast to one looking southward across the Ohio.

PLATE III.

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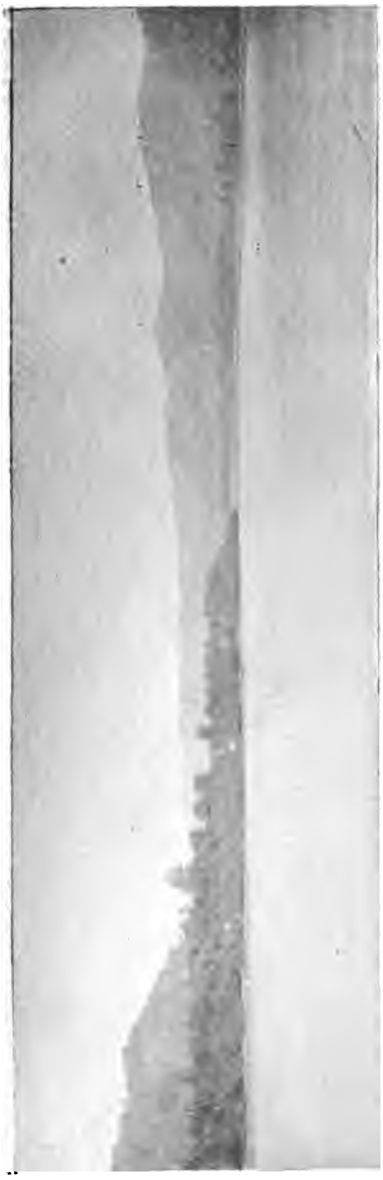

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1. Lowell Col on the Muskingum.

2. Meigs Creek Col on the Muskingum.

The valley of Duck Creek resembles much that of the Little Muskingum. The lower part of the valley is much broader and the hills more rounded than in the middle and upper sections. This lower course has the appearance of recent occupancy by a larger stream than originally cut the valley. This fact associated with some of the features farther up the valley suggests that there have been several modifications of the streams but they have not been fully worked out and are left with question marks on the map. The suggestions indicated on the map will serve as a working formula for further investigation.

CHARACTERS OF THE WOLF CREEK AND LITTLE HOCKING VALLEYS.

Wolf Creek heads in northern Morgan county on the divide which was crossed by the Muskingum when it broke over into this basin. It flows soutward many miles closely parallel to the Muskingum, much as the Little Muskingum parallels the Ohio. Its valley is narrow and deep. It broadens gradually towards the south of the point where it turns eastward when it narrows rapidly to the col a few miles above its mouth. Near the mouth of the valley; just above the junction of its South Fork there is an old deserted ox bow of considerable interest. This ox bow seems to have been cut off at the time the flood waters cut out the col above. The valley is quite narraw at the cut off, The hill which occupies the center of the ox bow rises almost as high as the surrounding general surface. Below the mouth of the South Fork the valley is very broad and the hills more rolling.

This valley does not seem to have ever been cut down to the level of the deep channel of the Muskingum. It seems as though the lime stone stratum which forms the floor of the valley at its mouth had prevented the valley from becoming well graded to the level of the deeper channels of the larger streams.

The valley of the South Fork of Wolf Creek is very markedly different from that of the main creek. Throughout most of its length this valley is comparatively broad and open and bounded by more gently rolling hills. At places the walls are rather steep but that is the exception rather than the rule. In the upper waters the contrast with the head water features of the

main stream are most striking. The country around the head waters is rather flat or gently rolling with very deep soils. Many of the smaller tributaries rise in extensive swamp areas. These swamp areas often lie on the divide which separates the waters of Wolf Creek from those of the Little Hocking. The slope of this divide on the north side which is drained by the tributaries of Wolf Creek is much less dissected than the south slope which is drained by the tributaries of the Little Hocking.

The Little Hocking valley is divided into two main branches which are very similar to each other in characters and present no special modifications from the normal. They are rather narrow with moderately steep valley sides. Every where are present the marks of the recent rejuvenescence. The valley of the East Fork occupies much the broader depression in the old land surface. Several of its tributaries on the north side, like the head waters of the South Fork of Wolf Creek, rise in the flat tracts on the same divide. The tributaries on the south side of the East Fork are all short, as the East Fork, like the Little Muskingum, parallels the Ohio throughout its entire length and is separated from it by a high ridge but a few miles wide.

CHARACTERS OF THE HOCKING VALLEY BELOW ATHENS.

At Athens there is a large loop in the Hocking River and the valley is quite broad. Some distance below the city the present river has crossed an old col. The valley is not as narrow as might be expected but the presence of the old col is shown by the vertical cliffs that face the river and the persistency of the old water shed at its maximum elevation, up to the very walls of the valley.

Below this col the valley gradually widens and the walls become less precipitous, although they remain quite steep, to the bend at Guysville. Below this point the valley gradually narrows again to the mouth of Federal Creek. Below this the narrowing is much more abrupt and at the point marked col on the map the valley is a very narrow gorge with vertical rock walls. There were here several channel ways during the cutting out of the old col by the present river. Some of these were cut nearly

PLATE IV.

Hocking Valley, a few miles above Coolville.

TIGHT — Drainage Modifications.

to the present level of the river so that the bold rock cliffs and the numerous deep ravines present very picturesque scenery. Below this col the valley gradually broadens again and the walls become less precipitous as far down as Coolville, (plate IV). Between Coolville and its mouth the river again passes through a narrows. That the narrows at this point is the site of an old col is not so evident as in the other cases farther up the river.

CHARACTER OF THE FEDERAL CREEK VALLEY.

A study of this valley was not included under the outline planned for the work for the Academy, but it soon became evident, from the field work, that under one of the working hypotheses it might prove to be in the line of discharge of the waters of the Muskingum, so that its investigation became necessary. The divide separating the waters of Federal Creek from those of Wolf Creek and the Little Hocking was carefully examined for an abandoned valley floor, but none was found. There are some low cols in the divide which may possibly have been occupied by water during some of the high water stages associated with the drainage modifications.

The valley of Federal Creek is rather deep and narrow in its lower portion, but in the section around Amesville is much broader. All the tributaries on the northern side occupy rather broad valleys. The effects of the rejuvenescense which are so marked a feature throughout most of the region are less apparent in the Federal Creek basin than anywhere else in the entire region. The data upon which rests the location of the old col below Amesville are not as satisfactory as could be desired. The location is made more from the necessities of the case than from field observations.

CHARACTERS AND DISTRIBUTION OF THE OLD VALLEY FLOORS.

It is very evident that as soon as a river deserts any part of its valley, the abandoned portion will develop at once into a divide from which the waters will flow each way into the remaining sections of the river. This will be especially true if from any cause a river course is divided and one portion caused to

reverse its direction of flow. It therefore becomes a common characteristic of these abandoned valley floors that they are located on present divides and it follows that wherever found, the old streams crossed the present divides at such points. They will therefore be discussed in connection with the divides in which they occur. As already mentioned, these flat low lands associated with the present divides form one of the notable exceptions to the general topographic features. The most striking case of this kind is the divide which separates the waters of Wolf Creek from those of the East Fork of Little Hocking. In this divide there are three well marked cases and several less notable ones. Those at Layman, Barlow and Fleming are the most important. They were the subject of study by Dr. S. P. Hildreth who wrote as follows in his report of 1838 concerning the valley at Barlow.

"On Mr. Lawton's farm, in Barlow, township, Washington county, in the midst of the marl region, is a locality of fossil fresh-water shells of the genus Unio. They are imbedded in coarse sand or gravel, cemented by ferruginous matter. The spot on which they are found has once evidently been the bed of an ancient lake or pond. It is now a beautiful valley of a mile or more in width by four miles in length, surrounded by low hills. On the south side a small branch drains the superfluous water into the Little Hocking. In digging wells for domestic use in this tract, beds of sand, gravel and plastic clay are passed to the depth of thirty feet, containing imbedded branches of trees, leaves and fragments of wood of recent and living species. Similar valleys and levels are found in the uplands of the western part of the county, lying between the headwaters of the creeks, and are a kind of table-land. From the frequency of these flat lands between the headwaters of the Little Hocking and the south branch of Wolf Creek, it is quite possible that at some remote period the waters of Wolf Creek were discharged into the Ohio River instead of the Muskingum. This opinion is strengthened from the fact that the head branches of the South Fork now rise within two miles of the Ohio, and run northerly, parallel with and opposite to the course of the Muskingum for twelve miles, and joins that river twenty miles

from its mouth. The remains of its ancient beds would form pools and ponds of standing water, furnishing fit residences for the fresh water shells, whose fossil remains are now found there. Great changes evidently have been made in the direction of all our water courses before they found their present levels."

The valley floor at Layman is not quite as large as that at Barlow, but it did not carry as large a stream. Several fields in this old valley floor show still, under cultivation, a black valley soil and the writer was informed by Mr. J. A. Gage, of Layman, that at one place there is a deep muck from which much decayed wood has been taken and the waters issuing therefrom have a very disagreeable odor.

The old floor at Fleming is still smaller than the others and probably carried a smaller stream. The full depths of the silt deposits that cover these floors was not determined as all the wells examined were very shallow. The bordering hills associated with these old valleys were very low and well graded and usually carried very deep soils which they often retain at present, where not exposed to the erosion of the more recent cycle.

Not directly in this divide but associated with the Wolf Creek basin is another abandoned valley floor near Watertown. This floor lies about two miles northeast of the town and about a mile east of the South Fork of Wolf Creek. Rainbow Creek heads on this floor. Whether all or only a part of the stream which occupied this Rainbow Creek valley drained over this floor is as yet undetermined. If there were other cols on the Muskingum below Lowell and the reversed Rainbow Creek carried a section of the present Muskingum, they will require very careful detailed work to determine, as the erosion of the valley of the Muskingum has been so great in this portion that almost every trace of such cols has been lost. There are some indications in the character of the divides which would seem to locate one such below the mouth of Bear Run. If this should be certainly located it would follow that both Cat Run and Bear Run drained through Rainbow Creek reversed and over the old Watertown valley floor. The location of this col is not indicated on the map as it was not considered sufficiently well established.

One of these sections about a mile east of Torch shows about eight feet of a sandy clay graduating into the much decayed underlying rock and overlain with about two feet of gravel and this with about five to six feet of the loess-like silt.

Both east and west of Torch the old valley floor is deeply cut by recent erosion into many very picturesque ravines and gorges. This is especially true on the west. The railroad follows up one of these ravines from the valley of the Hocking onto the old valley floor making a grade of about 125 feet in about two miles. This old floor extends westward to the Hocking and crosses the Hocking valley at Coolville. A cut on the pike in the main street of the village shows a fine section of the gravels in which the shingling to the southwest is very marked.

From Coolville the old valley is a very conspicuous feature in the typography as it extends southwestward past Tupper's Plains (Figure 2, Plate VI) and into the basin of Shade River. Between Coolville and Tupper's Plains the old valley floor is deeply cut by a small tributary of the Hocking. At the Plains the old floor forms a part of the divide between this tributary and the East Fork of Shade River. A few wells sunk in the valley penetrate from twenty to thirty feet of clay silts to a water bearing sand or gravel layer.

Two other remnants of old valley floors may be referred to, though somewhat beyond the exact limits of the major topic of this report. One of these lies between the headwaters of Rush Run, a tributary of Federal Creek, and the Hocking; the other on the divide separating the middle fork of Shade River from the Hocking and about a mile south of Guysville. These are of importance in connection with the drainage changes of Federal Creek and the lower part of the Hocking below Athens.

RESTORATION OF THE OLD DRAINAGE SYSTEM.

With the general features of the region, the position of the old eroded cols, which cross the present valleys, and the positions of the remnants of the old valley floors, thus very briefly presented, it seems possible to trace with a considerable degree of certainty the old drainage system. This is represented on the map in red. This reconstruction is based on many detailed

observations of elevations and gradients of the old valley floors, and measurements of valley widths and amounts of erosion, which it is not possible to present in a sketch of this kind.

It will be seen by a glance at the map (Plate I) that the old system coincides with the present drainage along most of the smaller streams. Middle Island Creek and the Little Muskingum were the main headwater branches.

Tributary to Middle Island Creek was a small stream which headed at the New Martinsville col and flowed along the present course of the Ohio as far as Newport. The northward deflection of the old drainage at the mouth of Bull Creek was probably caused by the great strength of the ridge separating the latter from the Little Kanawha basin already referred to. Below the mouth of the Little Muskingum the Duck Creek tributary entered. This was probably smaller than the stream in the present Duck Creek valley. The next tributary was that of a stream which carried the drainage of the section of the Muskingum below Lowell and probably much of that of the headwaters of the present Duck Creek. The Little Kanawha was the next stream to enter the main line which followed along the present Ohio. Just at Parkersburg the Little Kanawha is deflected somewhat to the west of its former line of discharge, the old outlet being blocked with deep clay deposits. Below Parkersburg the old stream followed the present Ohio as far as the mouth of the Little Hocking. Here it received a branch almost, if not quite, as large as itself. This branch comprised several elements. The first one on the east was composed of the drainage from the head water region of the present South Fork of Wolf Creek which crossed the old valley floor at Fleming into the present valley of the East Fork of the Little Hocking. The middle element was made up of the Meigs Creek, Olive Creek and Big Run drainage and the section of the Muskingum above Lowell and below the Meigs Creek col. These waters entered the mouth of Wolf Creek and followed down the East Fork reversed and through the old valley at Barlow into the East Fork of Little Hocking.

The western element included the present basin of Wolf Creek and that section of the Muskingum between the north

Morgan county line and the Meigs Creek col. These latter waters crossed into the Wolf Creek valley through the gap south of Roxbury and thence southward through the old valley at Layman into the Little Hocking.

Below the mouth of the Little Hocking the old stream passed through the old valley floor at Torch, crossed the Hocking at Coolville and thence through the old valley at Tupper's Plains into the basin of Shade River. At Coolville it receives a short tributary, along the line of the Hocking which headed at the col below the mouth of Federal Creek.

Along the line of the present Middle Fork of Shade River the old stream received the waters from the section of the Hocking blow the Athens col, including also those of the Federal Creek basin. These waters crossed the ridge through the gap south of Guysville. Concerning the further course of this old river it may be stated that since the work was completed which forms the basis of this report, much more field work has been done and it is known that the old river passed westward across southern Ohio and found its way into the Scioto. A more detailed report is now in preparation covering the entire history of this old valley. The normal characters of this old system are shown on the map Plate VI, which presents the old drainage separated from the present. It is noticeable that this old normal drainage conforms very closely to the slopes of the old upland surface.

THEORETICAL CONSIDERATIONS.

Within the limits of this paper it is not possible to discuss at length the probable factors involved in the production of the modifications of drainage from this old restored system to the new or present form. However, it may not be out of place to offer a few suggestions of a theoretical nature with the hope that they may be helpful in the further study of the phenomena themselves. The first and most natural question that arises is, if the restoration, as worked out, truly represents the conditions of drainage prior to the present, what produced the change? The answer to this question may not be found in the study of so limited a field and the phenomena therein presented. From the work previously done in

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adjacent regions it appears that the drainage modifications therein observed were intimately associated with the phenomena of the glacial period. The blocking of the northern discharge of the Monongahela and upper waters of the Ohio by the advancing ice or its extensive deposits turned the waters of the present upper Ohio region over the New Martinsville col into this basin. In a similar way the waters of the Muskingum which originally discharged westward past Newark and into the Scioto were deflected southward over the old col on the north Morgan county line. The conditions in the case of the Hocking are not so clear and at once suggest that there were other factors present besides the simple introduction of these large streams at particular points. For if the waters of the Hocking were set over the Athens col, due to the damming action of the ice or its deposits, on some northward flowing stream, it would seem as though it would have followed down the Middle Fork of Shade River branch of the old drainage and would not have crossed the col below the mouth of Federal Creek. As this region is far beyond the direct action of the ice and the only glacial deposits of note are the gravel trains found in the valleys of the Ohio, Muskingum and Hocking it at once becomes evident that the modifications wholly within the region must have been produced in some other way than by the direct action of the ice or its deposits. Such for example are the modifications of the lower Muskingum within Washington county. If the waters which headed at the north Morgan county line col were flowing over the gap south of Roxbury and through the old valley at Layman at the time the Muskingum waters first crossed this col it would seem that the larger stream would have followed the more direct and open line of the old drainage than to have turned to the north over the Meigs Creek col and again over the Lowell col. It seems necessary to assume one of two possible explanations. First, that there was some obstruction to the old direct line or that the modifications antedate the introduction of the Muskingum waters and that when the waters came over the col they followed the drainage they discovered already established, which was practically coincident with the present system. Of these two explanations the last seems best to fit the facts

as they appear in this and neighboring districts. If then the modifications were not produced by the glacial floods which were poured over the cols into the basin, but antedate the advent of these larger streams, some modifying cause must be found which could have produced the changes under the action of the old drainage itself. The necessary factor seems to be supplied in the silt deposits which occupy the remnants of the old valleys. These silts often exceed thirty-five feet in thickness. They must have been deposited under exceptionaal slack water conditions. It is believed that their deposition on the floors of the old valleys so choked up the old drainage that it was compelled to follow new lines which were often over the low cols in the divides and that these new lines were well established when the glacial waters were poured into the basin. The limits of this paper will not permit the full discussion of the problem, but it is hoped that sufficient has been said to show the very great interest that is involved in the study of the geographic geology of the state and to stimulate further research along these lines by members of the Ohio State Academy and others.

HISTORY OF THE LITTLE MIAMI RIVER.

By J. A. Bownocker, D. Sc.

The headwaters of the Little Miami river lie on the glacial plains of western Madison and eastern Clarke counties. The two chief tributaries, known respectively as the East and North branches, unite about two miles north of Clifton to form the Little Miami proper. The valleys of these branches are narrow, but increase in width and depth to the south, though nothing but drift is seen until just north of Clifton where the Niagara limestone appears in the bluffs to the west.

At Clifton the river bids adieu to these commonplace surroundings. Flowing directly over the Niagara limestone, it forms a series of rapids and cascades, and then enters the gorge, which is 80 feet deep, but at the narrowest point not more than one-fourth of that in width. Down stream the gorge widens and at the same time the bluffs become less precipitous. Soon a narrow flood plain appears, and farther down a strip of farm land is found. At Jacobis mill the valley becomes conspicuous. The valley from this place to Clifton may be compared to a greatly elongated V with the apex at Clifton. Everywhere the bluffs are of limestone, making certain that the gorge and valley have been cut from rock, and not from drift as above Clifton.

South from Jacobis the valley widens comparatively rapidly, owing to the stream having left the hard Niagara limestone and entered the much more easily eroded Hudson series, consisting of shales and thin bedded limestones. Nowhere below the north margin of the latter foundation was the stream found directly on rock, but everywhere on a mantle of drift which is of variable but usually unknown depth. At Trebines station a few miles west of Xenia a well located 50 yards from the river was sunk to a depth of 49 feet without penetrating rock.

At Alpha the valley expands greatly, though the only tributary there uniting with the Miami is Beaver Creek—a very small stream in a very large valley of which more will be said

hereafter. About one mile south of Alpha the valley again contracts, there having a width of perhaps one-tenth of a mile. At this point the valley lies about 75 feet below the top of the bluffs which are steep and composed of rock. Two miles farther down, the valley has again expanded and has a width of one-half mile. From the latter point to Bellbrook there are several variations in the width of the valley. These result largely from the entrance of tributaries and in part from the irregularities in the deposits of drift, and perhaps also from variations in the durability of the rock.

Just east of Bellbrook and north of the point at which the Miami turns abruptly to the east, there is a marked change in the width of the valley. Here the rock bluffs extend so close to the river that the flood plain on one side is only 85 yards wide, while on the opposite side there is scarcely room for a wagon road. A cross section of the valley here is shown in the following figure.

Fig. 1 Cross Section of Miami at Col just above mouth of Sugar Creek

Of special interest is the terrace east of the stream. It is in rock and has a pronounced slope *up* stream. From this point the valley widens, rather slowly up stream and rapidly down. The constriction in the valley and the expansion in both directions, the terrace sloping *up* stream, and the abrupt bend in the river just below, make certain the existence of a col at this place.

At the point where the Miami bends sharply to the east it is joined by Sugar creek which, though the smaller stream, flows through the larger valley. While connecting these two streams one mile north of this place there is an abandoned valley. The following sketch will indicate these relations.

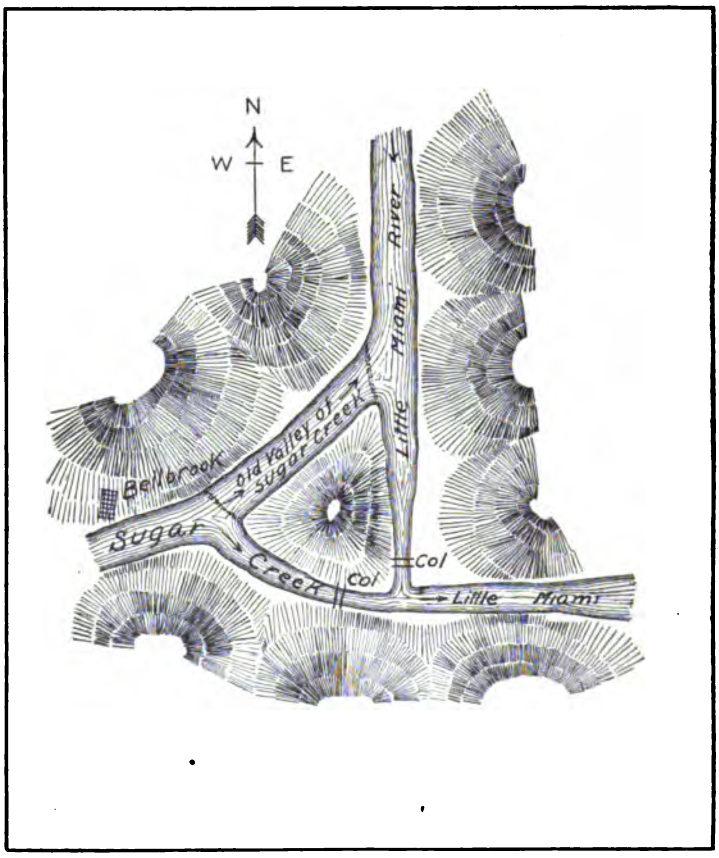

FIG. 2.

Opposite Bellbrook, Sugar creek flows through a valley nearly one-half mile wide. From this place it narrows down stream, reaching the minimum width a few hundred yards before it unites with the Miami. From this point the valley expands rapidly in both directions, and here is located another col. On the east side of this valley is a terrace standing about 70 feet above the creek.

As already stated there is an abandoned valley connecting Sugar creek with the little Miami about one mile north of the point at which the two streams now unite. This abandoned

valley is about one-half mile wide, and so corresponds to the present valley of Sugar Creek at Bellbrook. Similarly it harmonizes with the Miami at the place of junction with that stream. These relations show plainly that Sugar Creek formerly flowed through this old valley, and thence northward in the valley of the present Miami.

The Miami valley below the point of junction with Sugar creek was occupied by a stream which flowed east to Spring Valley where it united with another stream which will be discussed later.

Now the question how was the change from these conditions to the present produced? The answer is not difficult to find. It is one of the many changes produced by the great ice-sheet which formerly covered the northern half of the continent. The existence of a terminal moraine across the valley at Alpha shows that the ice front once stood at that place. This effectually blocked the course of the north flowing Sugar creek. The waters were ponded in front of the ice forming a long and narrow but deep lake. The waters rose higher and higher until they overflowed the divides, thus starting the streams in their present courses. The rapid flowing silt laden waters soon lowered the divides thus draining the lake, but not until its bed had been rapidly silted with drift. After the withdrawal of the glacier the streams found it easier to continue in their new channels than they did to clear out the drift deposits and resume their preglacial courses.

From the point of junction of Sugar creek and the Miami, the latter flows east to Spring Valley and thence making a sharp turn runs due south for a few miles. The valley widens until just opposite Mt. Holly where it is a mile or more in width, not being exceeded in this respect by any part of the valley except just above Cincinnati. Everywhere in this section of the river there is a heavy mantle of drift. About ten years ago a deep well was sunk at Spring Valley, and according to the best evidence now obtainable 170 feet of drift were found. This well it should be noted was on the north side of the valley in the angle made by the sharp bend in the stream. More recently two deep wells

were sunk at Waynesville, but these were at the foot of the hills and only about thirty feet of drift were found.

From the great width opposite Mt. Holly, the valley contracts rapidly to the south. At Waynesville it is only four-tenths of a mile wide, while at Oregonia 6 miles farther down it is less than one-fourth mile in width. The valley continues to contract until a point is reached about three-fourths of a mile south of Ft. Ancient. At this place, locally known as the "Narrows", the bluffs of limestone extend directly down to the river, there being scarcely room for the railroad tracks. No rock, other than drift, was observed in the channel at this point, nor could the depth of drift be ascertained.

Below the "Narrows" the valley widens gradually, but does not become prominent until Morrow is reached. The relations at the "Narrows" indicate the existence of a col at that place. At Morow where the river turns abruptly to the west it receives Todd's Fork, an important tributary from the east, and immediately below the point of junction there is a marked increase in the width of the valley. This sudden change must be due to Todd's Fork; and the wide valley below the place of junction, to the preglacial work of Todd's Fork and not to the much younger stream, the Little Miami.

From Morrow to South Lebanon the valley continues without noted change; but just west of the last named place the river, making a sharp bend, flows due south, and immediately the valley begins to narrow. The change is so rapid that just north of Fosters the valley has become a gorge, there being barely room for the railroad on one side of the river and the public road on the other. After retaining this character for a fraction of a mile the valley widens gradually and continues without abrupt change for a number of miles to the south. Another col exists at the narrows immediately north of Fosters.

Now the question—how shall we interpret the drainage phenomena observed from Spring Valley to Fosters? The answer to this is found in the location of the cols and the character of the valleys. From the col at Ft. Ancient a stream flowed north to Spring Valley where it received an important tributary from the west as already described. From the same col probably a

small stream flowed south uniting at Morrow with Todd's Fork, a much larger stream. It is to the controling influence of the latter that the present Miami makes its abrupt bend at Morrow. From Morrow the preglacial Todd's Fork continued west to South Lebanon in the valley now occupied by the Little Miami. Just west of the last named village a small stream, having its headwaters near Fosters, flowed north and then northwest through the present valley of Muddy creek and soon united with the ancient Todd's Fork, which from South Lebanon flowed northwest through the valley of Turtle creek, and thence into the valley of the present Great Miami at Middletown. From the col at Fosters a stream flowed south through the valley now occupied by the Little Miami.

The change from these early conditions to the present is not difficult to explain. The margin of the ice sheet, known as the early Wisconsin, crossed the old valley just west of South Lebanon and also the valley of the present Miami between Oregonia and Waynesville. This completely blocked the old courses of these streams, and, ponding the waters in front of the ice, formed small lakes. One of these lay between the ice front and the col near Ft. Ancient. Gradually the waters in this small lake rose higher and higher until they crossed the col and started on their southerly course. While this was happening a much larger lake was forming in the Todd's Fork valley. This lake extended from the margin of the ice west of South Lebanon up the valley of Todd'sFork beyond Morrow. These waters rose until they overflowed the col at Fosters which they soon lowered. The level of the waters fell proportionately and soon the lake disappeared, but not until its bed had been much clogged with drift. The thickness of the latter is not known. At King's Mills the shot tower well passed through 62 feet of drift without reaching rock. While this bed was being deposited the floor of the lake near Ft. Ancient was likewise being silted, and the same is true of the old valley west of Lebanon. The clogging of the latter was rendered more complete by the moraine which crosses the valley at that place. When finally the ice withdrew the preglacial courses which were so filled with drift that the streams were compelled to continue in their new channels.

From Fosters south the valley widens fairly regularly to a short distance below Milford. Everywhere the stream flows over drift. At Loveland a well 35 feet deep passed through two thin ledges of limestone, thus showing that the drift at that place is not deep. Below Loveland the quantity of drift increases. At Miamisville the gravel forms a terrace 62 feet high on which the village is located. Just below Camp Denison the Miami has abandoned its old course, and now occupies a channel farther east which is separated from its former valley by a knoll of limestone. Just south of this place is the town Milford, which, in the language of Dr. Orton, "stands on an island of blue limestone" and is surrounded on all sides by deep channels of erosion. The old valley of the river lies to the north and east of the town. These changes may be the result of the heavy deposits of drift which clog the valley in this vicinity.

A mile and one-half south of Milford another marked change occurs in the character of the valley. At that point East Fork of the Miami unites with the river, and immediately there is a decided increase in the width of the Miami valley. East Fork has in places a valley a mile or more in width, and lies 200 feet below the general upland. The valley of the Miami below the mouth of East Fork is comparable with the valley of the latter, but not with the valley of the Miami above the point of junction. These relations indicate that the Miami valley below the place of junction is really a continuation of the valley of East Fork, and that the breadth of the former is really due to the work of East Fork long before the present Miami was born. In those early days a tributary whose headwaters were near Fosters flowed south through the valley of the present Miami, and united with the waters of East Fork where this stream now unites with the Miami.

From this place to the junction with the Ohio the Miami valley is everywhere prominent. At Newton, four miles below Milford, it is more than a mile in width and it is several times wider than the Ohio just below the point of junction of the two rivers. These relations suggest important drainage modifications in the vicinity of Cincinnati, though it is no part of the purpose of this article to discuss these.

Having now traced the several streams from which the Little Miami was formed, and shown in what manner these were united to make the present river, let us consider further those parts of the preglacial streams which are not a part of the Miami. Let us first return to the mouth of Turtle Creek and examine that portion of Todds Fork which lies between the point last named and Middletown. The old valley through which this stream flowed is very conspicuous, and has long been known. It was first mapped by Dr. Orton and published with his article on Warren county in volume three of the Ohio Survey.[1] The width of the valley varies from about a quarter mile to more than a mile, the latter width being found near Middletown. The valley is so flat that the old canal which extended from Middletown to Lebanon was without locks. The depth of drift in the valley is not known. Two wells have been founa in which the rock is reported to have been struck at a depth of about twenty feet. This shallow depth may be due to an old island now buried, or more probably to a slab of limestone having been dropped in the old valley by the ice sheet and then covered with drift.

Two or three miles west of the mouth of Turtle Creek a branch valley leaves the main one. This extends north and east passing the city of Lebanon, where two deep wells only a few hundred yards apart showed depths of drift of 126 and 256 feet. Just west of this city the wells which supply the place with water showed only 90 feet of drift, but these were located at the extreme side of the valley. Beyond Lebanon this old valley can be followed to the Little Miami with which it unites a mile or two above Oregonia. The bed of this section of the valley, however, is not flat. There is a rapid rise east from Lebanon to a point about one mile from the Little Miami, where the valley stands 190 feet above the adjacent river and 65 feet below the table-land in which the valley is cut. From this place the valley slopes rapidly to the Miami. The width of the valley at the summit is between an eighth and a quarter mile. Only twice in this tributary valley is rock shown in its bed; once at

[1] Geol. Sur. of Ohio, Vol. III, p. 382.

Lebanon where the course of the stream has been changed by man and only a few hundred feet from where one of the deep wells was sunk; and the other perhaps a half mile from the point at which the valley unites with the Little Miami. This tributary valley may be explained in two ways: (1) It may have been occupied by two streams, one flowing into that part of the ancestral Miami which flowed from Ft. Ancient to the north, and the other to the southwest past Lebanon and thence into the abandoned channel which constituted a part of the preglacial course of Todd's Fork. These streams must have been so situated that their headwaters tapped the divide at the same point, thus producing the present continuous valley. (2) The other method by which this valley may have been formed was by an old stream flowing from the present Little Miami past Lebanon and thence into the main valley farther south. To this theory there are two objections: (1) The stream occupying the adjacent portion of the ancestral Miami flowed north. Under such conditions it is difficult to understand how there could be such a cross stream; (2) the rock in the valley a half mile from the Miami and above the level of the latter is also against this theory.

Caesar's Creek, which unites with the Miami between Oregonia and Waynesville, flows through a narrow valley in its lower course, but two or three miles above its mouth the valley is at least a half mile wide. The divide between this stream and the Miami is everywhere of rock except opposite Mt. Holly where it is very low and composed of drift. In fact this divide is a part of the Wisconsin moraine which skirts the east side of the valley at this place. The gorge-like character of Caeser's Creek near its mouth, the expansion of the valley a few miles up stream, and the low divide composed of drift leads to the conclusion that Caesar's Creek is part of the reversed stream, which once united with the ancestral Miami opposite Mt. Holly. This interpretation it may be added is in harmony with the great width of the Miami at the latter point.

Now the question—what became of that branch of the ancestral Miami which we have traced as far north as Spring Valley? This question cannot be answered as definitely as we might wish. But there seems to be only one course possible

and that was northwest towards Alpha. In any other direction a wall of limestone is encountered. The territory between Spring Valley and Alpha was once the margin of a great ice sheet and when this receded it left a morainic deposit which not only prevented the northward flow of the stream but entirely obscured the old channel. From Alpha its course is plainer, because from that place an old valley a mile wide in places can be readily followed northwest by Osborn where it is crossed by the Mad river, and thence on past New Carlisle to the Great Miami at Tippecanoe. The lower part of this old valley is occupied by a small stream, Beaver Creek, which is insignificant when compared to the valley through which it flows. The other end of the valley is occupied by Honey Creek, likewise a stream which grossly misfits its valley.

At two points only was the depth of drift in this old valley learned. At Osborn there are 207 feet and at New Carlisle 300 feet. Nowhere in the valley was bed rock seen. From these relations it appears not unreasonable to conclude that the old stream which has been traced to Spring Valley continued northwest past Alpha, Osborn and New Carlisle, and reached the valley of the present Great Miami near Tippecanoe. The stream could not have continued north far in this valley, however, for between Troy and Piqua the river flows in a very shallow channel on a bed of limestone. Neither could it have continued west of the Great Miami because there a solid wall of rock is found. To the suggestion that the stream may have turned south at Tippecanoe and flowed through the present valley of the Great Miami there is the objection that the Great Miami itself is regarded by some as a reversed stream. There appears then only one course for it to have taken, that is north along the east side of the Great Miami to just above Piqua where there is a great expansion of the valley and where the drift is more than 124 feet deep. But the old river could not have followed this valley far, because it contracts rapidly and a few miles up stream flows over rock again. About two miles north of Piqua there unites with the Miami, Laramie Creek, a sluggish stream that drains Laramie reservoir situated a few miles to the northwest. This stream everywhere flows over a

mantle of drift and in a deep valley cut out of the same material. The valley is narrow near its outlet but expands up stream, and near the station, Dawson, is fully a half mile wide. A large portion of this valley is undulating, and the irregularities found suggest that it is an old valley filled, rather than a young valley cut out of the drift. It seems to the writer that this valley is preglacial and that the old stream may have flowed through it to the vicinity of Berlin and there have entered the buried channel which has been traced to that place.

The channel to which reference has just been made was studied during the summer of 1898, and the report published in the American Geologist for March of the following year. During the summer of 1899 the work was continued and the mapping of the valley extended. These channels are shown on the map which accompanies this report. As may be there seen, they lie in Champaign, Shelby, Auglaize, Allen and Mercer counties, Ohio, and in Adams, Jay, Blackford and Grant counties, Indiana.

It must be borne in mind that all surface indications of these channels have been destroyed by the great ice invasions. So completely have they been filled that the present streams in places flow at right angles to the preglacial ones. In fact the course of one of the old channels in eastern Shelby county is now the site of a watershed separating the drainage of Lake Erie from that of the Ohio river.

Our knowledge of the location of these channels is due entirely to the driller for oil and gas; and progress in mapping these is likewise dependent upon him. All that we can do is to patiently follow the drill as it moves from section to section, and tabulate the facts which it discloses. Wherever this work ceases there also the work of mapping the old channel discontinues. For the facts relating to the greater portion of these channels reference must be made to the article in the American Geologist already referred to. It is proper here to discuss such additions only as have been made since that article was published.

Work during the past summer has been along two lines: (1) Tracing a tributary of the main channel in Auglaize and

Allen counties; (2) following the channel westward in Indiana. These points will be considered in order. In Washington township, Auglaize county, Ohio, near the Shelby county line, a well in section 23 shows 298 feet of drift; while in section 22 immediately to the west there are 76 feet only. In section 14 due north from 23 a well showed 300 feet of drift without striking rock. The depth of drift outside the channel in this locality cannot be stated since no wells have been drilled there.

In Wapakoneta two wells have been sunk, one on the east side of the city and the other on the west. The former disclosed 125 feet of drift and the latter 90 feet. One mile north of the last well 130 feet are found. One and one-half miles northeast of Wapakoneta in section 16 two wells disclose depths of drift of 398 and 400 feet, with a mile and one-half northwest only 68 feet are found. This shows a drop in the rock floor of 332 feet in the surface distance just given.

The next point at which the channel is struck is in section 34, Duchouquet township. These wells are near the village of Cridersville and just south of the Allen county line. Two wells there disclose depths of drift of 400 and 486 feet; while within a mile either east or west of these the depth is less than 130 feet. From Cridersville the channel runs northeast into Perry township, Allen county. In the northeast corner of section 25 there are 394 feet of drift, while one-fourth mile due south from this there are only 166 feet, and one-half mile northwest only 123 feet. Obviously the channel is here very narrow. To the northeast in section 20 there are 350 feet, but beyond this the drill discloses no marked variations in depth of drift, and so the channel could not be followed farther. The apparent shallowing of this channel to the northeast indicates that the flow of water was to the southwest.

In German township, Allen county, from three to five miles northwest of Lima, several comparatively deep drives are found. In section 15 there are 235 feet; in section 16 there are 262 feet; in section 8 there are 214 feet. But these depths of drift are intermingled with very much shallower ones, so that their interpretation is not easy. Possibly they may result from several deep but very narrow canons.

It may not be improper to say a few words here concerning the continuation of the channel which was mapped last year as far as Anna, Shelby county. Southeast from this village no deep wells have been drilled and so the continuation of the channel cannot be shown with certainty. It may be recalled, however that at the town St. Paris, Champaign county, a drill passed through 530 feet of drift without reaching rock, while east and west of this place the drift is comparatively shallow. The distance of St. Paris from Anna is more than 20 miles and the writer is loth to connect these two points without records at intermediate places. However south from Anna the drift shallows and at Sidney the limestone appears in the river bed. East also from Anna the drift becomes thinner, as is shown by the deep well at Quincy. While these points are not conclusive they indicate that the channel cannot extend either south or east from Anna, while the great depth to the southeast indicates that it extends in that direction and that the channel at St. Paris is a continuation of the one traced as far as Anna.

A few words remain to be said concerning the channel in Indiana. In the report published a year ago, and to which reference has already been made, the channel was traced across Jay and Adams counties into Harrison township, Blackford county. It enters this township in section 20 and passes through sections 26, 35, 34 and 33. The maximum depth of drift reported is 430 feet, while outside the channel the drift is very shallow, not more than 50 feet in places. Near the southwestern corner of this township the channel curves to the northwest and enters Washington township, where depths of drift of 438 and 440 feet were found in sections 20 and 17. Many other deep drives are reported in this locality so that the channel can be definitely located. Continuing in the northwesterly course the channel passes from Blackford county and enters Monroe township, Grant county, where, in the southeast quarter of section 12, 430 feet of drift were found. The channel can be traced through sections 12, 13, 11, 10, 3 and 4 of this township, and then through sections 33, 32, 31 and 30 of Van Buren township, Grant county. In the latter township the depth of drift appears smaller and according to M. W. Page of the Ohio Oil Com-

pany does not exceed 300 feet. From this township the channel enters Washington township and continuing in the northwesterly course can be traced to its center, where in the southeast quarter of section 15, 348 feet of drift are found. Beyond this point the channel cannot be traced at present.

SOME OBSERVATIONS ON THE PREGLACIAL DRAINAGE OF WAYNE AND ADJACENT COUNTIES.

By J. H. Todd, M. D.

In presenting this paper to the Academy I simply wish to lay before you—for your criticism—the results of careful observations on the present drainage system of Wayne and associate counties, together with the relation it sustains to pre-glacial channels, and to a topography modified by glacial forces.

The associate counties are Medina, Ashland, Richland, Knox and Holmes; but even parts of these (with all of Holmes) must be excluded from any associate activity in the *initial* forces that determined the pre-glacial drainage lines. Although later, and before the glacier's advent, they became potent factors in establishing an outlet for the waters, their hills were not in existence when the first lines of drainage were cut; and these first lines are still marked features in our landscape.

These counties rest on the Waverly capping of the north-east face, or incline, of that island or low mountain chain known as the "Cincinnati Arch." Here the arch, owing to its hood of hard Waverly, is least eroded; and, although in Kentucky it presents in intaglio, and at Cincinnati only in slight relief, here the Waverly stands out in bold headlands forming a crescent of highest hills in the State, which decline rapidly to the bed of Lake Erie, and show the original topography, scarred by the original drainage lines.

In studying the Waverly group of rocks in this part of the Island, I find that they dip away rapidly on the west to the oil regions, and on the north under the bed of Lake Erie, while on the east they decline more gradually into the synclinal trough of the Allegheny coal basin; thus constituting a water-shed in three directions. Prof. Newberry says (Vol. I Geological Survey) "It will be noticed that the direction of the drainage streams, which follow the strike of the strata on either side, indicates that it once formed a water-shed that gave the initial bearing to their flow."

Any one walking as I have walked, from Wooster by Hayesville and Mansfield to Bellville; and then crossing the profile from Ashland to Loudonville: will see this fact demonstrated to convicition.

In the first tramp (Wooster to Belleville) you cross all the streams that drain the eastern face of the plateau; and the elevations, as determined by barometer, may be instructive. Wooster University stands 522 feet above Lake Erie. Killbuck Valley 332, Jefferson, on rock summitt of plateau, 600, the flood plain of Muddy Fork 432, and the divide between this and the Jerome Fork 650, while its flood plain is 450. Hayesville, on the summit of the divide between the Jerome and the Black Forks, 700, and the flood plain of the Black Fork at Mifflin is 500, the depot at Mansfield 581, and the plateau south of the city is 800, and above Bellville 900. In the cross section from Ashland to Loudonville the divide between the Jerome and the Black Forks, independent of glacial deposits, is almost a level plane, with only a gradual descent of rock strata of about 50 feet.

The valleys in which the streams run average about three-fourths of a mile, and the rock floor averages about 150 feet below the present bed of the streams, while the rivulets and creeks that form the streams, start from the rock with the dip of the rock, and only mar the strike of the strata by erosion as they proceed.

The above presents a picture of the extreme eastern face of the plateau, showing the uniformity of elevations between streams, and the gentle dip of the plateau to the north and east, as well as the depth to which it was eroded by pre-glacial streams. Prof. Newberry further says: "A current from the south swept the eastern shore of our ancient Atlantis that floated the trunks of tree-ferns and branches of lepidodendron to Sandusky." This *current* gave the *initial* direction to a pre-glacial stream that, in after time, carried the waters not only of the Waverly but of the virgin coal hills as well, to the great channel through the bed of Lake Erie.

The crescent of the highest hills spoken of, that bound the elevations, and head the present streams, presents one horn resting on Medina county, the other on Knox, while the center

includes the Savannah Lakes in Ashland county. It forms the rim of a bowl or hydrographic basin, and its pinnacles of highest hills show as the zig-zag wanderings of a worm fence.

The rivulets and creeks dovetail and intertwine like the locking of fingers; while all along the crest are to be found, between the exposures of native rock, the remains of old lakes, gravel knolls, cat swamps, sink holes, and millions of boulders, the largest two lying near Lodi and Ashland, with an estimated weight of 300 and 350 tons respectively.

The elevations of this rim above Lake Erie are, Wadsworth 700 feet. But Wadsworth is underlaid with coal, and is therefore east of our pre-glacial channel, *which must run exactly between the Coal Measure hills and the Waverly capped Island.*

Seville is on carboniferous conglomerate, and is situated west of the valley of the river Styx, which drains the coal fields north and west of Wadsworth. It is just on the edge of the Coal Measures, and its elevation is 403 feet above Lake Erie, while drillings in the vicinity show 300 feet of drift. This makes a rapid decline of near 600 feet in six miles to the rock bottom of the Seville valley, and the surface decline continues west into a broad valley, where we are justified in assuming the same amount of drift with a lower well head, although no drillings have been made in the center of the valley.

On the west side of this valley 1½ miles east of Leroy, and southwest of Chippewa Lake, a drilled well shows 149 feet to rock, and going north east to a point 4½ miles due south of Medina village, and northeast of Chippewa Lake, a drill was sunk 190 feet and no rock was struck, but ¼ miles north, *Waverly* rock was struck at 125 feet. While 1¼ miles south, rock was struck in Carboniferous conglomerate at 42 feet, showing a northeast channel through Chippewa Lake on the edge of the conglomerate.

Following this line to a well three miles due east of Medina, near the head of Rocky river, I find 140 feet of blue clay above 60 feet of white sand; the well was abandoned at 200 feet without reaching rock, as sand ran up the pipe to water level. This well head is 180 feet below Medina and it makes the bottom of this drill hole 133 feet above Lake Erie.

This is not conclusive, but it shows no rock bottom at a level lower than Wooster and Orrville, and provides an outlet for the waters of Wayne county to Rocky river, and thence to the lake *between the Coal Measures and the Waverly.*

Ascending from this well to Medina village the elevation is 513 feet above Lake Erie, and crossing the divide between Rocky and Black rivers I find the surface elevation at Lodi to be only 282 feet; thence up to West Salem the register gives 575; at Polk 640; above Ashland 650; at Savannah lakes 700; north of Mansfield 862; and by the registered grades of 892, 912, 932 and 952 I am on the Belleville hills, and ascending to the south of Independence I find myself on one of the highest pinnacles in the State, about 1000 feet above Lake Erie.

Note the graded ascent of the crest that divides the waters, or rather note the descent, and remember that this decline in elevation means the gradual dip of a plateau, the face of which presents north and east.

The streams that drain this basin all trend east or southeast, toward one central axis, and this axis was primarily Prof. Newberry's current from the south that swept around this headland to Sandusky; and next, during the putting down of the Coals, the forecasts of these channels supplied fresh water to the coal marshes in the Allegheny basin: and lastly, after the Coal Measures were elevated to their present level, the axis channel became the trough to carry the waters from both the Coal and Waverly hills to the great pre-glacial river that ran through what is now the basin of Lake Erie.

This large hydrographic basin is now made up of six smaller ones; the Clear Fork, Rocky Fork, Black Fork, Jerome Fork, and Muddy Fork, of the Mohecan river; and the mysterious basin of Killbuck from Wooster to Burbank, where a glacial dam breaks its association with Black river, and fills a scallop or "Water-wier" in the Waverly, below the present surface of Lake Erie. These streams all run in broad valleys, with flood plains near a mile wide; they are separated by high table lands which showed—before the glacier's advent—evenly bedded rock strata, but now they are crushed like a ship in arctic ice. The bed and trend of these streams conspire to impress you—not

so much with their individuality—as that they are parts of a whole, converging to a common axis of drainage, and this axis is the trough between the Coal hills and the Waverly from Loudonville to Lake Erie. The P. F. W. & C. R. R. follows this trough from Loudonville to Wooster, and its record of levels will tell us the grade of descent. Mansfield is 578 feet above the Lake, Lucas 518, Perrysville 433, Loudonville 412, Lakeville 378, Shreve 352 and Wooster 342 above Lake Erie, making a decline of 236 feet between Mansfield and Wooster or about 6 feet to the mile.

This old waterway is clearly defined from Loudonville to Wooster, and from there is easily traced by Orrville and Chippewa Lake to Rocky river; that portion between Loudonville and Wooster is bounded by high and rocky hills of Waverly on the northwest, and Carboniferous conglomerate on the southeast; and the channel ran the entire distance, exactly between these too widely different geologic formations. It is filled to varying depths with gravel, and sand, and clay; its surface presenting a broad and fertile valley, with soft undulations between kames, kettle holes, and cranberry marshes.

Its rock floor, however, is of greater interest to the student of preglacial water ways, and, beginning at Loudonville, a drilled well shows this rock floor to be 150 feet below the village, making our starting point 262 feet above Lake Erie. Next, near the bridge over Lake Fork, where a preglacial channel comes in from Mohecanville, the rock floor is determined by the chain of lakelets that marks its course; their depth being about 130 feet, and the surface elevation here being 375 feet gives the rock bottom 245 feet above Lake Erie. Applying the same rule at Odel's Lake, through which the axial channel passes, I find rock at 228 feet; and at Big Prairie with a surface elevation of 390 feet, a drilled well shows 176 feet of drift, making the floor 214 feet above Lake Erie.

Near Alligewi (Custaloga) Junction between Big Prairie and Shreve, where the precursor of the Lake Fork, that tore out a channel 10 miles long, 1½ miles wide and 400 feet deep—counting from hill tops—thus creating the "Big Meadow" of the Indian and the "Big Prairie" of the Pioneer, entered the axial channel by

Brown's Lake, the surface is very deceiving. The drift seems piled in without order—now rising into hills 500 feet above the lake, and resembling a divide, and now sinking to the plains of the prairie—but a well was drilled here on the plane, at the Brown farm, to water at 170 feet—no rock encountered—and as the well head's elevation was 380 feet, it shows the rock floor to be less than 210 feet above Lake Erie.

Two miles from this, at Shreve, the elevation is 352 feet, and many wells have been driven to water—the only object sought—which is found in white sand under blue clay at from 60 to 105 feet. So I am safe in assuming the rock floor to be less than 200 feet, as the continuance of a channel is unquestioned.

Still, if the channel at Shreve should be regarded as a tributary from the coal hills of Holmes county—and here such a preglacial channel does come in—it would not modify the facts given above, nor embarrass my water-way to Wooster, as there is another way for the waters to proceed. A channel which was possibly used during the later history of the coal beds, when changes of level were common, and shiftings of coal into Waverly, and Waverly back into coal, were frequent, is traceable west of the Shreve hills—in which is found a small pocket of No. 7 coal—and it returns to the axial channel through the preglacial channel at Millbrook.

A very little digging would now turn the Lake Fork into Killbuck. So little that the A. & W. R. R. were afraid to run their track from the clay plant in the Big Prairie to Millbrook through this valley, for their engineer assured them that their track would be flooded if they cut half a mile through the gravel barrier that divides the Big Prairie from the Millbrook valley, as the flood plain of Big Prairie is 150 feet above that of Killbuck. This channel will be more fully studied in the future.

On the Troutman farm, near Millbrook, and where the above old channel comes in, a well was drilled on a gravel knoll elevated 376 feet, to the depth of 185 feet, but no rock struck; four furlongs east on the Webb farm, a well was driven to water at 100 feet and no rock encountered; while two furlongs a little south of east, and one furlong from the hill, rock was struck at

40 feet. These drillings were all on Sec. 6, Franklin township, Wayne county.

It would seem that between Shreve and Wooster, where the widening channel from Millersburgh enters the axial channel, the rock floor has been deepened as well as widened and a preglacial lake, tripod in shape, formed.

The spread of the rugged inclosing hills, the great flood plane known to the pioneers as the Killbuck swamps, and which to them became a lake at each "spring flood", all go to prove this. The basin would be 10 miles long from Wooster to Shreve and 8 toward Millersburgh, with a width of from 1½ to 3 miles; over this plane the Killbuck Creek then crept from hill to hill, and back again like the doublings of a snake. The Indian chief, Killbuck, made himself noted by killing a deer with an arrow from his bow that, on its errand of death, crossed the creek three times.

One drilling in the center of this lake, 1½ miles south of Wooster, and 5 miles from the cross section wells, with a well head of 330 feet, shows 185 feet to rock and 480 feet to Berea sand (which here has a thickness of 27 feet); this makes the rock bed of the channel only 145 feet above Lake Erie, and to this must all other levels conform, unless the lake character of a basin with a deeper bottom than the main channel can be proved. This brings me to the city of Wooster, and from here to Orrville I have a rough road to travel, but the preglacial water came here, and there was but one way for it to go out, and I must find that way *under* the high gravel hills between here and Orrville. On the south of Wooster is Madison Hill, on which is located the Ohio Experiment Station, with its quarry of elegant Coal Measure sandstone; and 1¾ miles north of it across Apple Creek valley, on a terrace of which is located South and East Wooster, Wooster University is planted on a hill of naked Waverly shale 522 feet above Lake Erie. Madison Hill has about the same elevation, and between them, but near 200 feet below them, sparkles the crystal water of Apple Creek. No drillings have been made in the center of the channel to the rock floor—so its elevation cannot be proven here—but many drillings have been made for water, which is found in white sand

at from 95 to 105 feet. One well was drilled to rock on the side of the channel, at the foot of College Hill and showed 120 feet to shale; while six furlongs east, across the Apple Creek, at the foot of Madison Hill, rock was found at 45 feet and the channel runs between these two wells.

From this throat at Wooster the axial channel proceeds almost due east for a distance of 8 miles to a point 2½ miles southwest of Orrville, near which the C. A. & C. R. R. enters and follows it in a northeast direction to Orrville. It is bounded by the same type of Coal Measure hills on the southeast, and Waverly on the northwest as at Wooster, but the trough is filled with drumlins of varying heights. At Honeytown, three miles east of Wooster, the Apple Creek enters it through a preglacial channel from the coal hills on the southeast; but it is so deflected by glacial *debris* that it turns on itself and follows the axial channel back to Wooster and thence to the Killbuck.

Near Honeytown I can give you a better record of rock floor; one-half mile east of that hamlet on the Mock farm—Sec. 7, East Union Tp.—a well was drilled to the depth of 185 feet and no rock found. The well head has an elevation of 345 feet and shows the rock floor to be, at most, less than 160 feet above Lake Erie. In the N. E. ¼ Sec. 2, East Union Tp., two and one-fourth miles southwest of Orrville, near the C. A. & C. R. R., a well was drilled through sand, gravel, and yellow clay, above 50 feet of blue clay, soft as mud, and the well was abandoned as hopeless in this "blue soap" at 110 feet, without striking rock, while one-half mile away in the S. E. ¼ of same Sec. hard sand rock was struck at 3 feet, but drilling was continued in the rock until at the depth of 50 feet a flowing well was struck which yields ten gallons of pure water per minute. This well was on the side of the channel. This would seem to throw a little light on the origin of the many flowing wells about Apple Creek, Shreve, Fredericksburgh, and along some of the preglacial waterways of Ashland county.

But I leave this in the satisfaction I feel in being able to demonstrate a deep preglacial channel under these hills that connects the axial channel with the broad valley of swamps that lie north and east of Orrville where it is joined by the out-

put of the dismal swamps bordering Newman's Creek, which seems to open—as a wedge—the coal measure hills of Baughman Tp. to drain them.

Of course I cannot demonstrate the elevations of the rock floor to these mysterious swamps, for no drillings have been made in these marshes to their bottom, that I am apprised of; but no geologist who has examined them has ever doubted the existence of a preglacial channel here. His only question has been, "To where does it go?" And I think I can prove to you, at least by circumstantial evidence, that the channel proceeds through these swamps north, and after taking in the waters of the Red Run region, goes northwest diagonally across Milton Tp. south of Sterling and east of Creston, where, after reversing or rather doing away with the necessity of a Chippewa Creek, it took up the waters of Killbuck's head from Wayne Tp. and carried them to Chippewa Lake to be forwarded to Rocky River.

One proof of this is found in the fact that two and one-half miles southeast of Sterling, in Milton Tp., an Artesian well, in the line of the channel, has for thirty years filled a three inch pipe with pure water from a depth of 80 feet, and no rock was encountered in its drilling. And second, when the A. & G. W. R. R. was building from Sterling to Creston, some fifty years ago, a section of the track sank out of sight, went down in the night to stay, and they had to change the line and use the wood from an acre of heavy oak timber to steady it in the new place. The third item of proof is that several wells have been sunk in the line of the channel east of Creston to 160 feet and no rock struck. These wells are in valleys some 50 feet lower than Creston village, as I am informed. I am also informed by a prominenet member of the U. S. Geological Survey that "a well at Sterling has about 400 feet of drift." I have been unable to locate this well unless it be one situated about one mile northwest of Sterling, near the Medina county line, which reveals great depth of drift, but the exact thickness I could not secure. Yet enough was secured to demonstrate a rock floor very nearly on a level with the surface of Lake Erie, or about the same elevation, as I will show in the Black River

channel, only 10 miles west, over the horse-back divide at Lodi.

Such a channel in width and depth, *could not have been produced by drainage from the north,* for, it is only 12 miles to the rock crest above Medina city, and but six miles to the north and south divide between Chatham and Lafayette townships.

It was on the foot hills of the east face of this divide that the two wells —noted in the early part of this paper—were drilled to rock, at the respective depths of 149 and 125 feet; they are 4¾ miles apart, and, joining them with the Medina city foot hill, 4¼ miles north, they mark the eastern extension of the Waverly as a surface rock, from Le Roy to Medina, a distance of nine miles. Opposed to this headland of Waverly I find the declining face of the last projection of the Coal Measures from Sharon to Seville, where the quarries of Carboniferous conglomerate are worked from the western face of the hill, and it was between these diverse and opposing faces that the primitive channel ran into that of Rocky river.

I must now search for a cause of sufficient magnitude to convert the drainage system described, into that of the present; a conversion that has created a new topography for a large part of the State of Ohio.

When the glacier passed from the soft shale bed it had plowed out for Lake Erie to lie in, it met two mountainous obstacles of greater, and yet unequal resistance; viz: the Coal Measure hills and the Waverly plateau, each still rising to the height of 700 feet, with the pre-glacial channel, over which now runs the Rocky river exactly between them; seven miles east of Rocky river, opened the wide mouth of the Cuyahoga, that drained the northwest face of the Coal Measures: a cross section of these, from east to west, through the center of Cuyahoga county shows (according to Prof. Newberry in Vol. I, Geological Survey) the pre-glacial bed of Rocky river to be 3 miles wide and that of the Cuyahoga 4½ miles, with the intervening Coal Measure projection only 7 miles. Now 14 miles west of Rocky river comes down across the Waverly the broad trough over which now flows Black river, and all these wide pre-glacial channels worn down into the Erie shale, below the Lake's present

level, making three broad and deep breaches between the prime obstacles barring the glacier's even progress. Huge as it was its course was modified.

Striae on the hills of Summit county are directed *southwest,* while on the pure Waverly of Richland and Ashland counties they are *southeast;* these scorings if *projected* would meet in the Killbuck valley. How could such scorings be produced? Is it not plain to anyone with operative intelligence, and a mind unbiased by pre-conceptions, that the broad inclined plane from Mansfield to Wooster, facing the high range of hills bordering the Tuscarawas valley from Massillon to Akron, would of necessity influence the ice-front, when a lower plane was there, and lead you to expect and search for just such glacial scratchings? Here were two forces acting the one against the other, and to gether they directed a lob of the glacier that had entered the inviting depression created by the three open channels across Cuyahoga ,eastern Lorain, western Summit, Medina and Wayne counties until it was stranded as a bow on the hard high hills of Holmes county, just before it reached the continental divide of the Coal Measures; this bow a little more than subtends the south front of Wayne county, the bowstring being about 30 miles long, while the central projection is about 8 miles to Millersburg, with the Killbuck valley as a fixed arrow in the bent bow,

This lobe of the glacier seems to have become detached from the main body just where the Coal Measures end below Loudonville in Ashland county, for the main mountain of ice slid on south over the smoother face of the Waverly that skirts the Coal Measures to below Newark, before it was deflected—a distance of 40 miles. Now, it was this arrested lobe of the glacier, that brought the load of material that changed the entire topography of the hydroghaphic basin described in this paper; from Cleveland to Millersburg, and from Massillon to Mansfield, its burden of *Life in Death* was put down, giving a new physiognomy and a new physiology to the landscape; and the remodeled features, with their fresh expressions, made the face of this valley a thing a beauty to the eye and a blessing to the nation; the angular hills and gorge-like valleys, were rounded

up into gentle swells, and smoothed out into graceful undulations, and the food in the "glacier's grist" was so digested and assimilated that hill and dale rejoiced in verdure unsurpassed, and there was left as our inheritance, as fine a grazing and wheat-growing section as the sun shines on.

But our old water-ways were obliterated, filled with drift to hundreds of feet above their holding, and new drainage channels must be created; a few of which, together with their mode of creation I will attempt to describe. The Clear Fork of the Mohecan, followed, in part, the old channel to near Perrysville, but was here obstructed in its course to the Black Fork gorge by drift; the obliterated channel being now distinguished by two small lakes—or kettle holes between the high gravel knolls that turned the waters. The deflected stream then cut a new channel southeast to the Mohecan, its newness being demonstrated by numerous falls, the most picturesque being Lyons Falls, where the stream cuts down into the crumbling red sandstone of the Waverly immediately below the Carboniferous conglomerate of an outlying coal hill, revealing many and beautiful casts of fossil. The Black Fork was blocked by morainic material where the Killbuck lobe of the glacier became fixed on the Loudonville hills; but it found a col a mile below the village, where the diverted Clear Fork rejoined it, and, uniting their forces they cut a narrow gorge through hills that now stand 425 feet above the rock bottomed and rock banked Mohecan. Here a mountain of sand stone and shale is cut in two as you would cut a loaf of bread. The next col is at Lake Fork where, because their old channel in the Big Prairie was walled up by a glacial dam now 180 feet high, the Muddy and Jerome Forks of the Mohecan were compelled to mingle their waters and tear down a low breach in the hills at Fort Tyler into a gorge 200 feet deep, and 3 miles long, through a divide, to gain—at Rochester a pre-glacial channel coming down from Mohecanville.

This channel of waters—now called Lake Fork—followed to above Lakeville, where they were again staggered out of their course by the hill like obstructions of glacial debris that here stopped transit in the axial trough, and, they must a second time cut a way through high conglomerate hills for 7 miles to join

the new channel of the united Black and Clear Forks, 5 miles below Loudonville, and create the Big Mohecan.

We now come to the mysterious Killbuck, the preglacial heralds of which entered the axial channel at Wooster, but its mystery is explained by the lately discovered fact, that it was not through its *entire course* that it so entered pre-glacial times—even from the north,— and its channel from the south will be discussed later.

Late investigation has developed a new feature in the Killbuck and Black river valleys, one that throws much light on the enigma of pre-glacial drainage in this region, and these newly observed facts make it necessary that I repeat a few salient points of my paper, and introduce additional detail.

I must especially recall to your mind the picture of an island in a Devonian sea; and this island made up of a fold of Silurian and Devonian rock, capped with deeply eroded Waverly. The head of this island was near the mouth of the Black river trough that drained this face of the Waverly; and its sides are now practically bounded by an imaginary line running through Norwalk, New Haven, Galion and Mt. Gilead—on the west, and on the southeast and northeast, by the Coal Measure conglomerate from Independence, by Loudonville, Wooster, Orrville and Rocky river from head to mouth.

It must be remembered that this island has never been entirely submerged since the elevation of the Waverly. Its surface constituted a plateau with only rounded and eroded edges, as determined by the strike of the strata, while the waters drained from it—owing to difference in *temperature* and *quality*—assisted greatly in developing into *permanancy* a current along its sides—from south to north—and around its head. This current was maintained during the putting down of the Coals and *instituted* the axial channel for all pre-glacial drainage in this region. On the west and north we had the progenitors of the Huron, Vermillion, Black and Rocky rivers; on the southeast and east we had the *initial* channels of the Clear, Rocky, Black, Jerome and Muddy Forks of the Mohecan river, and a portion of Killbuck channel, pouring their floods into this common current; and this, through all Carboniferous and subsequent time, until the gla-

cier's burden blocked the way. What a game of shuttle-cock must have been played between the *debris* of their floods, and the deposits in the coal marshes, from the frequent oscillations of land and sea during this æon of time; and how this shifting of *debris* and growth must have modified the course of the current at different times! And when we think of the corrosive influence of the atmosphere, and the erosiv power of the streams, we will not wonder at the great width and depth of the main drainage troughs noted above, nor at the occasional dove-tailings of the Waverly and the Coal Measures conglomerate that throws a shadow over the course of the mutual outlet for their waters.

Furthermore, not only was this water way obscured, but the entire face of the plateau was transmuted. Erosion had so marred its features, and glacial drift so deformed them, that my first examination was faulty and I must add to, and explain, the elevations noted in the early part of the paper. The line of highest hills there noted marks the present divide between Lake Erie and the Ohio river, but not the pre-glacial divide marking the crest of the Waverly. I found it to be south, and east of this line of hills. Entering Wayne county south of West Salem, it passes across Congress township about two miles south of Congress village, and crosses the Killbuck one mile north of Cedar Valley (now Overton) and entering Wayne township it intersects a north and south divide from Burbank to Wooster in such a manner as to almost present the picture of a turkey's foot, the central toe—the continuance of the continental divide—extending across Wayne township to Green and ending at Smithville. The right toe, being represented by a range of hills that run southeast to Wooster, where Wooster University is located on the extreme front, 172 feet above the city's square. From these two points the descent of the Waverly is very rapid until it disappears under the Coal Measures. The elevations of these spurs are, above Wooster 640 feet, above Smithville 700 feet, and the rock is badly crushed. The projection of the third toe is disgramed by a line of high elevations running from the heel at Cedar Valley, northeast across Canaan township, and almost paralleling the middle division of Killbuck valley—to

east of Burbank—where it was connected with the divide separating the Black from the Rocky river, and shows that a north and south pre-glacial divide in the plateau did exist from Medina to Wooster; and where it was crossed by the continental divide above Cedar valley, the Killbuck gorge was bisected.

Here the hills banking the Killbuck are less than 80 rods apart, although nearly 200 feet high, and the stream runs on a rock bottom.

From this point, and from all the northeast face of Congress Tp. the collected waters were carried into one channel, that of the Black River, at Lodi, and thence to the Lake. Drilled wells west of Burbank show 100 feet to rock; in the Harrisville swamps 90 feet, and its bottom is studded with innumerable boulders. Southwest of Lodi rock is found at 120 feet, and two miles northwest of Lodi on the Little Black River, the drill passed through 285 feet of drift before reaching rock, and the well head is 45 feet below Lodi; two miles north of this, where the valley is 20 feet lower, no rock was struck at 270 feet, and one mile northeast rock was not reached at 217 feet, but 1¼ miles east of the line of these wells, with well heads 45 feet above Lodi, rock was reached at from 200 to 204 feet and the ascent is very rapid from here to the crest of the divide between Black and Rocky Rivers, which follows the line between Chatham and Lafayette townships. Many other wells have been drilled in this region of which I have the records, but these are enough to show that the preglacial trough over which the Black River now winds its torturous course was many feet lower than the present level of Lake Erie. The next observation of interest made here is connected with the unique Killbuck, which now drains the northeast angle formed by the crossing of the divides near Cedar Valley.

Bisecting this angle was found a preglacial channel passing northeast through the Jackson swamp to join the axial channel near Creston. The three heads of the present Killbuck, after uniting, follow in part this old channel across Canaan Tp. to its northeast corner and there, turning abruptly west, the stream cuts its way for seven miles through the divide to the trough of Black River, where it again turns at an acute angle and pro-

ceeds southeast to Wooster, passing, after traveling 24 miles, within one mile of the springs that mark its head.

The explanation is this: When the great mass of morainic material which formed the hills between Creston and Sterling was piled into, and over the water-way, then as low as the Lake's present level, of course this channel was obliterated, as well as the one coming from Canaan Tp., now represented by the head of Killbuck. The dammed up waters of the Killbuck channel formed a lake at Jackson, and the obstructed waters in the axial channel created the larger lake from Orrville to Easton. Now these lakes must have an outlet, and the waters of the eastern one, now represented by Orrville swamps, Chippewa Creek, and the subterranean passage near Sterling, where fish came up when the railroad went down, cut its way by a low col in the coal measures at Warwick and gave birth to the Tuscarawas River.

The other, or Old Hickory Lake, forced a way directly across the north and south divide, creating a broad and rocky channel for Killbuck to Burbank, but the Black River trough was also blocked by a series of kames running east and west and forming the south border of a Lake imprisoned between Burbank and Lodi, now known as the Harrisville Swamp. So the Killbuck waters must search for a new way out, and being joined by the embarrassed waters of the northeast face of Congress Tp. enough force was generated to cut a narrow path through the continental divide near Cedar Valley, and so the Killbuck river was completed and sent on its way to join the Tuscarawas at Coshocton.

This completes the preglacial and present drainage of the northwest half of the hydrographic basin. The southeast half shows a rim made up of hills as high, and hard, and irregular, as those on the west and north, but of different material. The first were of Waverly, while these are composed of all the factors of the coal measures. Each of the seven numbers of the coals are represented, while limestone, and sandstone, iron ore, and chert are found as capstones to the rim of the bowl through all of Holmes county. The line of the divide starts near Independence and Bellville in Richland county, and passes through

the southwest corner of Hanover Tp, Ashland county, touching the northeast corner of Knox county, and crosses the Mohican four miles south of its junction with the Clear Fork and near its union with the Lake Fork. From here it runs northeast into Knox Tp., Holmes county, and crossing an enigmatical north and south divide that turns Black Creek to the east, it continues in a northeast direction across the township and enters Monroe Tp. at its northwest corner, then bending southeast it traverses the township nearly midway between Paint Valley and Welcome, and has for its crest the Blue Stone, of which the Millersburgh court house is built, and the red sandstone known as Killbuck red sand-stone. From here, after crossing the southwest corner of Hardy Tp. it enters the north corner of Killbuck Tp. and crossing the Killbuck River 4 miles below Millersburg, locates a narrowing in the Killbuck channel, supposed to be a col, just where that stream turns to the southwest to be joined to the Black Creek. From here this divide enters in an easterly direction the northwest corner of Mechanic Tp. and crosses the township in zigzags until it approaches the northeast corner where it turns abruptly northeast to Santillo P. O., then east through a stone-quarry region and on to a point two miles south of Berlin, where it again turns northeast and passes north of New Carlisle, where a new turn directs it to the limestone ridge above Weinsburgh. It here leaves the county of Holmes in worm-fence progression, possibly to Dundee, or in some other way to assimilate with the confining walls of the mysterious Tuscarawas.

I have not had the privilege of tracing it, nor determining the location of the col in the Big Sugar Creek, whence the waters were carried in preglacial times from the Newmans Creek channel north of Orrville.

But this I have determined, that a spur of the divide passes from near Weinsburgh by Mt. Eaton to Kidron, inclosing a territory that sent its waters to Kidron, and thence to the Apple Creek channel. Along this old water way, Artesian wells are secured from white sand at from 75 to 80 feet. This valley is followed by the new Camp Railroad from Kidron to Honeytown. It is no easy matter to determine the exact crest of the

divide, but the character and quality of the earth together with the strike of the rock strata, determines the trend of the rivulets that make up the creeks, and the creeks continue in the same general course until a ravine has been reached cutting into strata of lower geologic formation; here a new direction may be given, which is again modified by elevation and strike of strata. Unlike Wayne county, the strike of the strata in Holmes county is very irregular. We used all these points in following the line of divide, spending five days between Loudonville, Nashvillè, Napoleon, Oxford, Millersburgh and Holmesville, and the prime thing noticed, as obscuring the investigation, was the influence of the *glacial moraine* on the direction of the rivulets. The morainic material from Stark to Ashland county is abundant on an irregular line from two to four miles north of the crest of highest hills and gradually thins out to the crest, creating an intervening *border plain* where the rivulets seem to struggle to find a way out, and then,shuddering back, make crow-feet markings on the summit, or they huddle together, forming little pools, or they spread out to form peat swamps, like the notable one north of Berlin where the Ohio Ground Sloth (Megalonis Jeffersonii) was found.

Any one will recognize these important facts who will critically examine the line of the terminal moraine as platted by Prof. G. F. Wright.

I say important because they must be used in questionable cases, as the Sugar Creek and upper Tuscarawas regions.

This brings me to the preglacial channels that drained the Carboniferous side of the completed hydrographic basin and were tributary to the common water way. The first on the west was a small channel coming in just south of Loudonville and one mile north of the present confluence of the Clear and Black forks; it drained the higher hills of Hanover township and is crossed by the new bed of the Clear Fork. Drakes Valley from Nashville to Lakeville marks the line of the second.

The third in order drained the limestone highlands of Ripley and enters the main channel just west of Shreve. A well on the D. E. Foltz farm shows 91 feet to water but no rock. We are now at the south exposure of the Limestone ridge of

Ripley township and all its waters were directed by the dip of the rock to the Paint Valley channel, which started near Nashville and enters the Killbuck channel near Holmesville.

The next and principal tributary is the great Killbuck channel, in which the waters are now reversed. We located the col in this river 4 miles south of Millersburgh, but later observations reveal many facts pointing out Oxford as the site of the col, and that the Black Creek gorge sent its waters to Wooster. In driving from Nashville to Napoleon by a route west of the common, I found a range of hills starting from the east and west divide in Knox township that had not been considered in the first investigation, and although this discovery does not do away with the significance of the line of high hills there noted yet it does constrain me to believe that this divide was surrounded by a range of higher hills, and that the waters of Black Creek were included by them. This line continues almost parallel with the Mohican River to old Fort Fizzle, west of Napoleon, and from here is directed to the "Summit Ridge" in Richland township, and only separated from it by a strait so narrow that it seemed like a col. As the summit ridge is continuous to Oxford and forms the dividing ridge between Wolf Creek and Black Creek; and also because there is a line of high hills on the south side of Killbuck Valley that connects with, and is continuous with the line of hills in Killbuck township where I located the col, I fear that the former location of the col only noted the crossing of a line of hills, and that the true col was at Oxford. But leaving this for future investigation, when I will note the observations by barometer, I return to the sixth channel, a small one that comes in, between coal hills, two miles south of Millersburg from a fissure directed to Berlin. The eighth comes in from Salt Creek township, between Holmesville and the Holmes county infirmary. It is now occupied in part by Martins Creek. A drilled well here shows 196 feet to rock. The eighth in order is probably of more importance to the people of Wayne county than all the others combined, for it furnishes a series of flowing wells of the purest water. It drained a large portion of Salt Creek and Paint Creek townships in both Wayne and Holmes counties. I have only traced

the channel a short distance into Holmes county, where it is now represented by Dry Run, passing down a fissure between coal hills southwest of the south branch of Salt Creek, and entering the Big Salt Creek valley near the tile factory below Fredericksburgh; here it is joined by a small channel from the limestone hills of Wayne county. At this point is located the col in the Big Salt Creek, and from here the stream goes tearing over a rocky bed and between rock hills to Holmesville five miles distant. From this col the old channel passes almost due north to old Edinburgh, where it is joined by the preglacial channel coming in from Kidron by Apple Creek. It then proceeds in a northwest direction along the valley of the Apple Creek to Honeytown where it enters the main channel to the lake by Orrville.

This valley is one-half mile wide and is filled with drift from Honeytown to Fredericksburgh and Kidron, and flowing wells are secured on every farm in its course, except near Honeytown where the dam in the great channel is complete. The obstructing glacial hills rise to 200 feet above the plane and no rock is found below the flood plane at 185 feet, and Apple Creek is turned, like the Killbuck at Burbank, almost at right angles back to Wooster. In all the flowing wells water is found on blue boulder clay and in white sand. Fredericksburgh wells are about 100 feet deep, Apple Creek 120 and rock is reached at Apple Creek at 186 feet.

This completes the description of the channels tributary to the central channel, as far as the one represented by the Big Sugar Creek. And here I must call your attention to a feature in the location of these channels which will be better understood by referring to the map accompanying this paper, viz., all the channels that enter the axial channel from the coal measures enter it through fissures or gorges between coal hills; and this fact must help us in determining the original course of the channels now occupied by Sugar Creek, Newmans Creek, and Chippewa Creek; the waters now in them trend out, but we think this evidence shows that in preglacial times they flowed in.

First, as to Sugar Creek, in which the col is not located, it will be observed that it now passes up a ravine, between coal

hills, from a point in the axial channel that is more than 110 feet below its present bed; and second, that the rivulets from the innumerable springs that line its border, through all of Sugar Creek township to Stark county, have their primal direction with the strike of the strata, which is contrary to the present course of the stream.

Now the law of the other channels and coal hill fissures being applied to this would show the stream to be reversed. Nearly the same features with the same expressions are found in Newmans Creek for six miles across Baughman township, with this addition, the old dismal swamp of which this stream is the remains was shaped like an Indian arrow head, the point driven into the coal hills as far as the Stark County line, and along its sides coal banks facing each other, and all entered by drifts. The shoulders of the dart on the north and south are represented by short preglacial channels entering from the hills, while the stem is pictured by the mouth of the swamp as it entered the Orrville glacial lake. There is neither coal nor conglomerate under the swamp, but its margin is marked all around by conglomerate, and the environing hills are coal from the base of the dart to its point. The mines on its opposite sides, across the shaft of the arrow, are but half a mile apart, while at the barbs the hills are two miles apart, and the stem at its neck is half a mile broad, but it widens to near three miles where it enters the lake. It seems plain that this dismal swamp or "Shades of Death," as the pioneers called it, marked the line of a preglacial channel tending north and west.

The direction of the next preglacial channel was northwest from the coal hills to the axial channel, and is now indicated by Patton Lake, Fox Lake and Red Run, all located end to end in the Tamarack swamp, which is a marsh on the side of a hill.

The next channel, that through which the Chippewa Creek now flows to form the head of the Tuscarawas River, is from a scientific point of view the most important of all, for it has of late been a mooted question where the Chippewa Lake and the Sterling channels sent their waters in preglacial times.

The old supposition was that they went out by the Chippewa Creek channel to the Tuscarawas and thence to the Ohio River. But a later conception sent them by Warwick and New Portage to the Cuyahoga River and thence to the great Lake Erie channel, but in both of these the reckoning was made without considering the existence of the axial channel described, or the force of the Orrville Lake.

My first objection to them is that I have found another way through which the waters could proceed, and that the Chippewa channel passes over Carboniferous conglomerate that was once covered with coal. In other words, it shows a breach in coal hills that is not consistent with their formation, but which is in accordance with the idea presented above, that the dammed up waters of the Orrville Lake selected the point of least resistance to force their way through their prison walls, viz., the V-shaped fissure still recognizable in the coal hills on the sides of this channel. In sections 26 and 25 of Chippewa township coal mines are operated less than a mile apart with the Chippewa Creek channel between them, making the strait too narrow for the volume of water to pass. It would be like passing a two-inch ball through an inch augur-hole. But as it is not the outlet we are contending for, but only for the general trend of the main channel between the Waverly and Carboniferous, and its tributaries from the hills of widely separated geologic periods. I will wait for further developments before I will change my present thinking, that these waters went from the Orrville Lake across the Chippewa channel, receiving it as a tributary from section 26, through Chippewa Lake to Rocky River and thence to the great preglacial channel in Lake Erie.

PREGLACIAL DRAINAGE CONDITIONS IN THE VICINITY OF CINCINNATI.

By Gerard Fowke.

At the winter meeting of the Ohio Academy of Science, in 1897, I offered a paper upon the above subject. This was published as a Bulletin of the Scientific Laboratories of Denison University, in volume XI. Recently the opportunity has been afforded by the Academy, through the McMillan fund, for further exploration of the region. Some discoveries resulted which considerably modify so much of that article as relates to the section below Cincinnati.

In order that the reader may arrive at a correct understanding of the matter herein presented, it will be necessary to utilize such portions of the report already published as refer to the territory east of the Great Miami river, and acknowledgment is hereby made to the Denison University for permission so to do.

The initial point of this part of the Ohio was near Manchester, at the col (A). A few miles below, Cabin creek entered, and at Maysville it was joined by Limestone creek. For distinction, the name of the latter is given to the stream. At short intervals below, other tributaries put in, each marked by a large area of bottom land. Between them the valley is somewhat narrower. This is because gravels and silt cover the low points at the junction of the streams, where the combined valleys are widest. These features continue to the mouth of the Little Miami. The distance between the hills bordering this tributary is very much greater than the width of the main valley at any place above; and the shrunken stream which winds its devious way from side to side of the included level, seems entirely inadequate to the task of carving out such a basin. Immediately below this, at Dayton, Kentucky, opposite the upper end of Cincinnati, the Ohio contracts almost at once to a narrow channel, very much less than that of the Little Miami. It is evident that a col (B) at this point formerly deflected the waters of old Limestone to the northward. On passing through this gap, the Ohio

is seen to flow between extensive bottom lands on which stand the cities of Cincinnati, Newport and Covington. Here it receives the Licking from the south and Mill creek from the north; the latter, like the Little Miami, coming through a valley in which it seems almost lost as it meanders aimlessly back and forth. Then the Ohio passes into a very diminished space at Sedamsville, where it flows on rock bottom. This is the site of another col (C); and from here the hills gradually recede to North Bend. Three miles below North Bend was another col (D); a little farther down the Ohio suddenly debouches into a very broad valley where it receives the Great Miami. Like the two streams observed above here, the latter seems utterly incompetent to the excavation of the trough which it occupies.

This valley holds its width to the mouth of the Kentucky, varying somewhat from the average in different parts, as it does elsewhere. One noticeable feature along this stretch is that nearly all the tributary streams have a direction opposite the current of the river; that is, in going down the main stream one is looking toward the sources of those which flow into it. There are also several abrupt bends; in these the outer side of the curve is at the foot of the steep hills or cliffs, while on the other side are wide bottom lands. At Sugar creek the river makes an acute turn to the west, which course it holds past Carrolton, where it receives the Kentucky. From this town it rapidly narrows until it reaches Madison (E). Here was the last col above Louisville. The valley contracts until on the Indiana side the water washes the solid rock, while on the Kentucky side there is a strip of level land only wide enough to afford room for a single warehouse.

Two miles below Madison, the river turns again toward the south through a gorge which gradually expands until it opens into the basin in which Louisville is situated.

The interpretation of these facts is about as follows:

When old Limestone was deflected northward by the col at (B) it entered the depression lying north and east of Cincinnati. Here it received a considerable tributary from the east by way of the present East Fork. The united streams flowed west, and reached Mill creek valley at the point (G) in the vicin-

ity of Carthage. A short ravine joined them, from the hills where the Little Miami discharges, but that river was not then in existence, being a post-glacial stream.

It will be perceived that when old Limestone turned northward, it was separated from the Licking only by the col at (B). Between this col and the one at Sedamsville (C) the Licking flowed north into Mill creek valley where it continued its northerly course. Receiving old Limestone at (G) it passed on and entered the valley of the Great Miami at Hamilton.

From the west side of the col at (C) a ravine extended to North Bend. The hill behind this village, though apparently continuous with the blue limestone formations on either side, is composed of glacial material. This fact was first disclosed when the railroad which passes through here undertook to make a tunnel; it was found that the limestone was absent. Consequently only a cut was needed. This cut is in the lowest part of the deposit; the higher hills to the eastward are also composed of drift. This proves that the ravine from (C) formerly turned to the north at this point, reached the Great Miami valley at Cleves, and there turned west along the present course of the river.

The wide valley below the col (D) has an interesting history. It is continuous from Hamilton to the mouth of the Kentucky river. This fact, in connection with the rapid narrowing of the Ohio between Carrolton and Madison, together with the certain evidence of a col at the latter place, proves beyond question that this ancient bed was eroded by the Kentucky river. In other words, that stream, instead of following the present Ohio as it does now, or flowing across Indiana, turned to the east and north to join the Licking at Hamilton. There is no other channel through which it could have gone. The hills in every other direction, except at the gorge below Madison, are unbroken. From Lawrenceburg it extended almost due north through the valley now partially occupied by the Whitewater and Dry Run, to the point (H). Here it turned east, and at (I) reached the Great Miami, following that valley to Hamilton. From Hamilton northward the old river bed is filled with drift and has not been traced. There can be no doubt, however,

that it joined old Kanawha north of Dayton—probably in the neighborhood of Piqua.

The lower part of the Great Miami requires a few words of explanation. There was a col at (F), just south of the village of Miami. North of this Taylor's creek flowed north and emptied into the Kentucky at (I). South of the col (F), a small ravine joined the creek that flowed through the gap at North Bend, at a point somewhere near Valley Junction (K).

Having thus traced the former rivers and their tributaries, and located the cols, so far as they are essential to the problem, we are in a position to follow the steps by which the Ohio was established.

The Great Kanawha held its way across Ohio until the glacier had advanced to that part of its valley which extended farthest to the northward. For a time the waters may have skirted the ice-front, and recovered their natural channel farther down; but presently the valley was completely closed and the imprisoned waters found no escape until they had reached the level of the col at Madison (E).

At this stage began the readjustment of drainage channels. The principal stream at this time was, of course, the Kanawha. How far it may have extended toward the north or the northwest, we have no means of knowing; but it was probably first reached by the glacier at some place west of Ohio. Shut off by this agent from its natural outlet, it turned back into the old Kentucky, wherever their confluence may have been; followed that channel past Hamilton, Lawrenceburg and Carrolton and was impounded by the col at Madison (E). If we may judge from the nearly uniform level of the hills on either side of the river there, up to the very edge of the cliffs which descend steeply to the water, this point in the old watershed was but little lower than any other along the crest. Whatever its elevation, the Kanawha was compelled to rise to its level. As a result, a lake was formed which reached well up toward the headwaters of every stream between the Kentucky river and the Cumberland mountains on the south and to the eastern part of Ohio on the north. It had to reach the level not of the bottom of the gap, but of the highest flood of the torrents which poured

through the gap. The mythical "Lake Ohio," which is currently believed to have resulted from a blocking of the Ohio river by the glacier, would be insignificant by comparison—admitting, for the sake of comparison, that it ever existed as so frequently described. The area of the real lake, created by the Madison dam, can be ascertained only by carrying the level at which it stood at its outlet, up the Kentucky, Great Miami, Licking, Big Sandy, Kanawha, and across central Ohio toward the headwaters of the Tuscarawas. Until this level is ascertained we cannot know how much of the country was submerged, or how many of the existing high areas were drowned. Neither have we any means at present of knowing how long these conditions prevailed. They may have lasted until the col had worn low enough to drain off most of the accumulated water. On the other hand, the advancing ice may have pushed this water in front of it, and maintained a constantly diminishing lake until its most southern limit was reached. If we may suppose the former supposition to be the correct one, then a new river was established; following the Kanawha as far as the mouth of the Licking-Kentucky, and that stream, reversed, from there toward the south and west.

In time, the encroaching ice covered the site of its junction with these two rivers, and Kanawha was again deprived of an outlet. A second lake was formed, including the basin of the Kanawha and all its tributaries east of the Licking. It increased in area and depth until it surmounted the col at (A); flowing over this divide, its waters would follow old Limestone to its junction with the Licking at the point (G), thence north to Hamilton, and so find their way to the Kentucky.

The glacier reached Hamilton, and for the third time a lake was formed. Both Kanawha and Licking were now shut off; the water rose over the col at (C). The Kanawha reached this by following old Limestone as before to (G), and thence down the Mill creek valley. Pushing through the gap at North Bend, and past Cleves, they reached the Kentucky along the bed now occupied by the Great Miami below that village.

When the ice came to the hills about Cincinnati, the mouth of old Limestone at (G) was obliterated, and for the fourth time

Kanawha was backed up into a lake which rose until it overflowed the col at (B). Joining Licking again, the two followed their last channel as far as North Bend and probably out past Cleves; but there is a possibility that before the col at (B) was removed the ice had advanced far enough to reach the hill below North Bend and obstruct that outlet. In this case the new lake would have included Licking as well as Kanawha, and had to rise to the level of the col at (D) before it could have begun to drain off. If, however, the col at (B) was worn down in time for the water above it to escape past Cleves, then, when the ice had advanced across the valley below Cleves, a fifth lake covered the upper Ohio valley before the col at (D) was eroded and the present drainage to the mouth of the Great Miami establishd. It is possible there was still a sixth lake, though if so it was of less extent and shorter duration than any of the others, and was due to a projection or loop of the glacier pushing out of Miami valley as a dam to the new Ohio—which name is now applicable to the river for the first time—until its waters broke through a ravine back of Petersburg, Kentucky. The depression thus formed is usually spoken of as "an abandoned channel of the Ohio," but it was occupied only while torrents from melting ice were far above existing flood plains. It furnishes about the only evidence, by the way, that the glacier ever reached the Kentucky hills.

The theory advanced here in regard to the succession of glacial lakes is based entirely on the assumption that the col at Madison (E) was broken down sufficiently to drain the first one formed, and upon the further assumption that the ice reached each necessary point for the formation of a lake, in the order here given. There seems to be no doubt regarding the first and most extensive one; the existence of the others depends upon the strength of the col at (E) and the relative periods of time at which the subsidiary streams were blocked. It is not necessary to presume a constant forward motion of the glacier; its advance may have been frequently interrupted, or there may even have been an occasional recession without in the least invalidating the argument. The effect would be the same in the end, whether there was a continuous progressive motion, or

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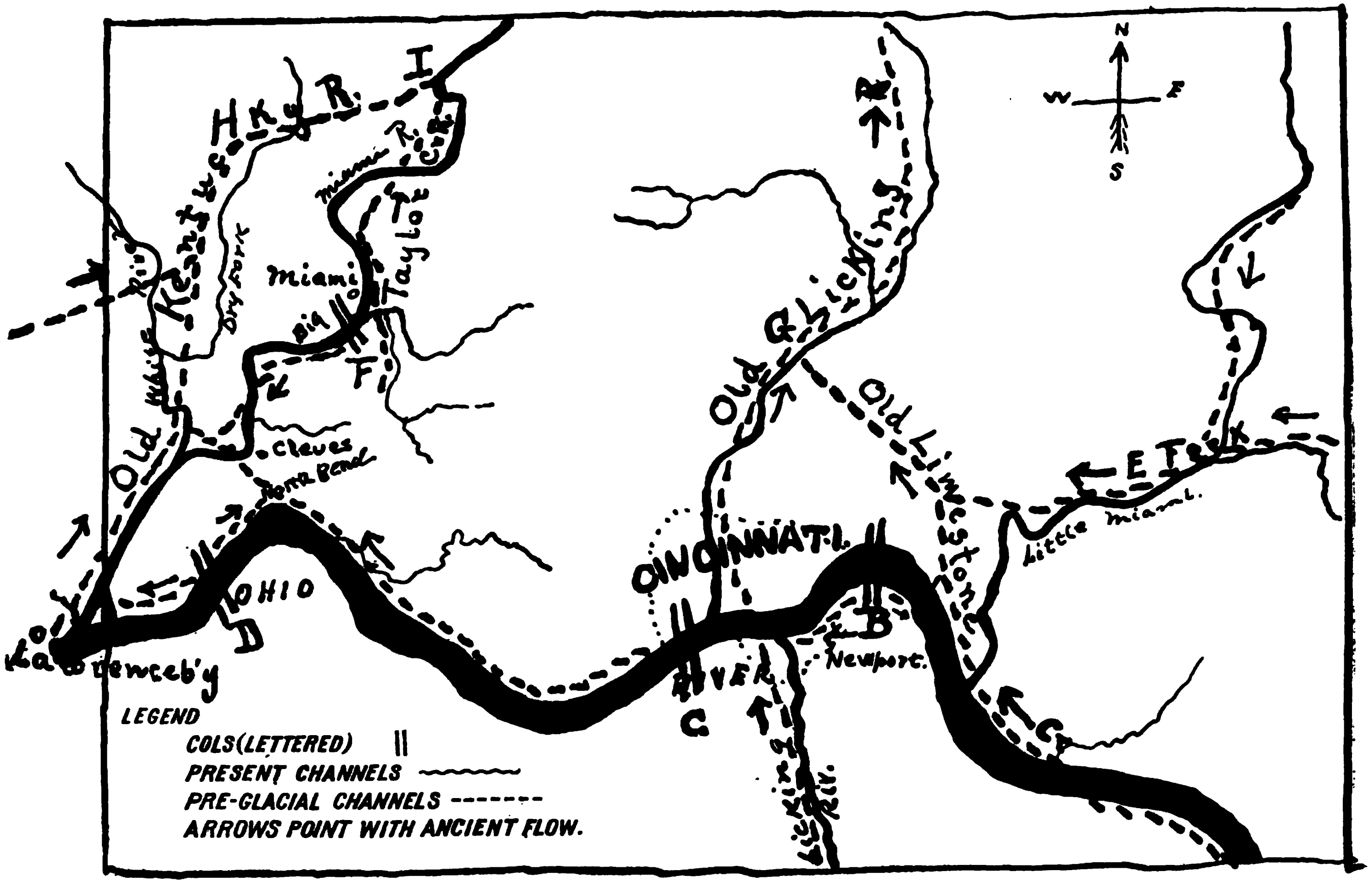
an intermittent action. Even if there was more than one glacial period, the sequence of events would not be greatly different from the series here described. The work was begun by the one which first blocked the Kanawha, and was completed by the one which extended farthest south.

When the ice retreated, the drift which it left behind shut the rivers and creeks off from their former ways, and they were left as we now find them. The channel of old Limestone has been partially taken possession of by the Little Miami and its East Fork; the part between these streams and its former mouth at (G) is deserted. Licking turns west at Covington, and its ancient valley from Cincinnati to Hamilton has been pre-empted by the insignificant Mill creek. The Whitewater, a post-glacial stream, and the mouth of the Great Miami use a fragment of the old Kentucky river valley in Ohio, but the part between (I) and (H) is abandoned. The Miami utilizes that portion of its channel between Hamilton and the point (I), where Taylor's creek formerly emptied; but the immense gravel deposits which were left here deflected the new river toward the east. It followed a small ravine for a short distance, then broke over a low place in the divide between this ravine and Taylor's creek, filled the latter to the col (F), tore this out, and at Cleves fell into the creek which came through the hill at North Bend; it went with that creek to the drift filled valley of the old Kentucky near Valley Junction, through which it has eroded its devious way to the Ohio.

A large creek entered the old Kentucky at the town of Harrison; the Whitewater crossed this to reach the ancient valley, leaving an island of Silurian rock between the former and recent beds, just as the Great Miami did at the gravel deposits at (I).

The old streams herein described flowed through valleys which were eroded to a considerable depth below the waters which now go through them. While the new channels were forming the old ones were being filled with sediments of mud-laden torrents and debris from masses of floating ice. The streams of today have not had time to clear out these deposits, so they remain as the bottom lands on either side of



N
W
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S
Old Kentucky R.
H
I
Miami R.
Taylor Cr.
Miami
Big
F
Dry Fork
Old White R.
Cleves
North Bend
OHIO
D
Lawrenceb'y
Old Licking
Old Limestone
CINCINNATI
RIVER
C
B
Newport
Licking Riv.
E
Little Miami
G
LEGEND
COLS (LETTERED)
PRESENT CHANNELS
PRE-GLACIAL CHANNELS
ARROWS POINT WITH ANCIENT FLOW.

Ohio State Academy of Science
SPECIAL PAPERS No. 3.

THE PREGLACIAL DRAINAGE OF OHIO

Comprising the Results of Researches made by Members of the Academy of Science, by the Aid of the McMillin Research Fund

Published by the Academy of Science
with the Emerson McMillin Research Fund.

DECEMBER, 1900